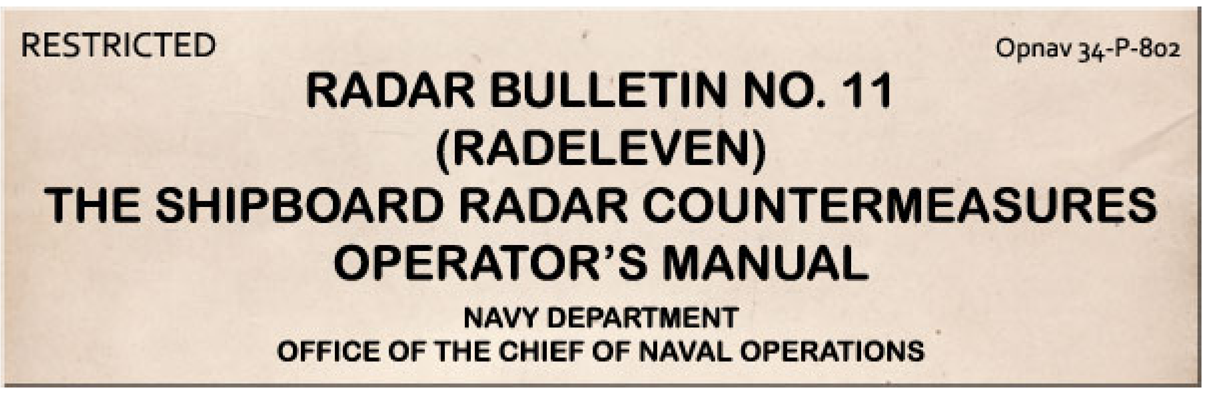

Opnv 34-P-802

RADAR BULLETIN No. 11

(RADTHREE)

THE SHIPBOARD RADAR COUNTERMEASURES OPERATOR'S MANUAL

[See also: General Instructions for Guided Missile Countermeasure Systems --*HyperWar*]

UNITED STATES FLEET
HEADQUARTERS OF THE COMMANDER IN CHIEF

NAVY DEPARTMENT
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON

RESTRICTED 18 February 1946

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JERAULD WRIGHT,
By direction.

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(25), NTS(MIT) (10), PSNYd(25) (Radar school), n(NTSch(Electronics)NYd, N.Y.

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List 11--Chrm., Gen Board(1), BuAer(10), BuPers (12), CNO(Op 25) (10), BuOrd(10), BuShips (10), Comdt MarCorps(10), Comdt USCG(10)

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TABLE OF CONTENTS

Introduction

Purpose of the Manual

This manual has been written for the radar countermeasures operator. It has a twofold purpose, which is as follows:

1. It give in detail the operating instructions and operating information for the radar intercept equipment and the radar jamming transmitter that he will find on board ship at the present time (1946-?).
2. It explains the operation of the complete radar countermeasures system with the emphasis on simplifying the work that he must do to intercept and identify the enemy radar, and to jam it when directed to do so.

The radar operator can be sure that the knowledge and skill that he acquired with the present equipment will also give him advance training and understanding of any new systems that may be brought out in years to come.

Material Based on Normal Operation

A manual of this type is based on equipment that is in normal operation. It is part of the operator's job to recognize the signs that indicate whether the different units are working properly or are in need of attention by the technician.

It is best to judge the performance of the equipment when the ship is at sea, far enough away from the harbor and other ships to give the system a chance to operate as it will under ordinary circumstances.

There are a number of specific things the operator can do to determine normal operation. The ability of antennas and receivers to pick up distant signals can be checked by such methods as maintaining an intercept on a known harbor radar as the ship increases its distance from it. Radar intercept to be effective must outrange the echo range of any radar by a decisive margin.

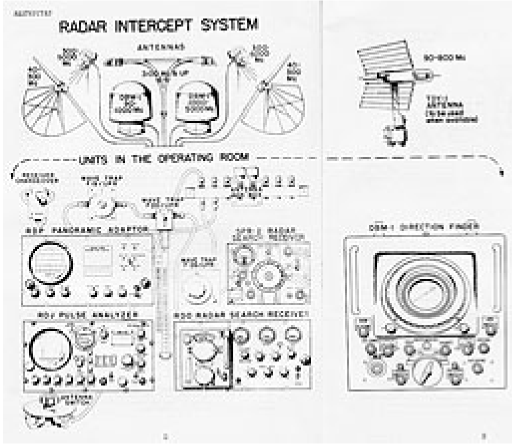
All the other units can be checked by observation or results obtained when a relatively distant radar response is tuned in. If the response is difficult to see or to follow on the scope of the panoramic adaptor, alignment of that unit may be needed. If the pattern is difficult to read on the direction finder, the technician may be able to clear up the trouble.

Ways to Use the Manual

There is no better way to use this manual than for the operator to have it before him as he operates the equipment. The following are recommended ways to use it:

1. For the operator who wishes to start from the beginning nto make sure the different units are properly set up for search intercept, a special index on page 3 entitled *'To Get the Search System Set Up'* will direct him to the pages that give step-by-step instructions as to what to do. Should he desire a full explanation of any control mentioned in one of the steps, it will be found on the page opposite the instructions under the same number as the step. It is a quick way to get the system ready to tune in a response on one of the receivers.
2. For the operator who wishes to obtain detailed information about the operation of any part of the search system, or of the jamming transmitter, the manual will provide a ready reference. A complete index of all material contained in the manual is given in the *'Table of Contents'*.

RADAR INTERCEPT SYSTEM

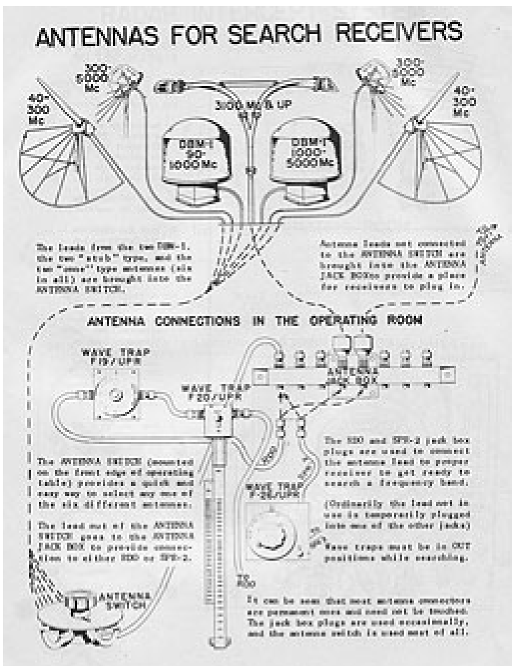


[Full-size image will open in a separate window for reference.]

To Get the Search System Set Up:

	Details on Page
For 40-1000 Mc Intercept:	
1. Select one of the antennas for the frequency band to be searched, and connect it to the RDO receiver.	5
2. Get RDO Receiver ready to operate.	10
3. Turn the RECEIVER CHANGEOVER switch to RDO position.	
For Intercepts Above 1000 Mc:	
1. Select one of the antennas for the frequency band to be searched, and connect it to the SPR-2 receiver.	5
2. Get SPR-2 RECEIVER ready to operate.	20
3. Turn the RECEIVER CHANGEOVER switch to SPR-2 position.	
For Use With Either RDO or SPR-2:	
4. Get RDP PANORAMIC ADAPTOR ready.	24
5. Get the RDJ PULSE ANALYZER ready.	30
6. Get DBM-1 DIRECTION FINDER ready.	36

Antennas for Search Receivers



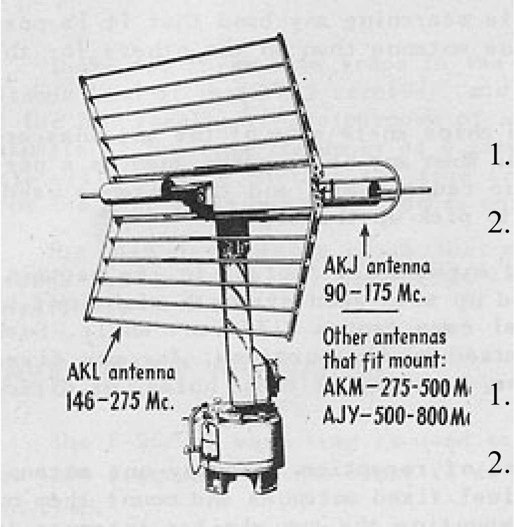
[Full-size image will open in separate window for reference]

TDY-1 Antenna Can Be Used for Search

When a ship is equipped with a TDY-1 jammer, it is generally an easy matter to use this rotating directional transmitting antenna for search intercept work without impairing the use of the jamming transmitter.

This is usually done by running a connecting lead from one of the jack box connectors to one of the connectors in the TDY-1 antenna lead, such as at the line stretcher, where the regular connector can be temporarily removed to permit use of the special lead.

In some installations a modification has been made so that the TDY-1 antenna can be used in place of the DBM-1 search antenna.



TO GET THE ANTENNA SYSTEM READY FOR DIFFERENT BANDS

To Search Below 300 Mc With Regular Intercept Antennas:

1. Plug RDO lead into ANTENNA JACK BOX that connects it to the ANTENNA SWITCH.
2. Turn ANTENNA SWITCH to either of the 40-300 Mc "stub" antennas, or to the DBM-1 ANTENNA NO. 1 (90-1000 Mc), which must be checked to make sure it is rotating.

To Search 300 Mc to 1000 Mc With Regular Intercept Antennas:

1. Plug the RDO lead into ANTENNA JACK BOX jack that connects it to the ANTENNA SWITCH.
2. Turn ANTENNA SWITCH to either of the 300-5000 Mc "cone" antennas, or to the DBM-1 ANTENNA NO. 1 (90-1000 Mc), which must be checked to make sure it is rotating.

To Search 90 Mc to 800 Mc With TDY-1 Antenna (if available):

1. Plug RDO lead into ANTENNA JACK BOX that attaches it to TDY-1 connecting lead.
2. Connect other end of TDY-1 lead to connector that attaches it to the TDY-1 antenna.
3. Check to see that the two TDY-1 antennas that might be needed are in place on the antenna mount, are polarized correctly, and the one to be used in connected in.
4. Get TDY-1 antenna control unit set up to provide antenna rotation (see page 52).

To Search 1000 Mc to 5000 Mc With Regular Intercept Antennas:

1. Plug SPR-2 lead into ANTENNA JACK BOX jack that connects it to the ANTENNA SWITCH.
2. Turn ANTENNA SWITCH to either of the 300-5000 Mc "cone" antennas, or to the DEM-1 ANTENNA NO. 2 (1000-5000 Mc), which must be checked to make sure it is rotating.

To Search 3100 Mc and Up:

1. Plug SPR-2 lead into ANTENNA JACK BOX that attaches it to waveguide antenna.

--5--

KNOW YOUR ANTENNAS--SAVE TIME, GET BETTER RESULTS

The operator must always keep in mind while searching any band that it is possible for a signal to be picked up better on one antenna than on the others for this same band.

One obvious reason for this is seen on the ships where some of the antennas are mounted at the same level as the superstructure. When any obstruction such as a part of the superstructure happens to be between the radar signal and the antenna used, it makes it more difficult or even impossible to pick up the signal.

A less apparent reason is that each fixed antenna has 'holes' in its pattern, which means that a radar signal that is picked up with good strength might not be heard ta all on the same antenna if the signal came from a different angle. Such holes are in addition to any difficulties caused by obstructions, for any fixed antenna, even one that is mounted free and clear, has many of these holes, or directions of poor pick up, throughout 360°.

The method of overcoming the difficulties of reception that any one antenna might have, is to provide ships with two identical fixed antennas and mount them on the port and starboard sides of the ship. By mounting the two similar antennas in different positions and setting them at different angles, each antenna can pinch hit for the other. When one antenna has difficulty picking up a signal from anywhere throughout the 360°, the other antenna may be able to receive it satisfactorily.

In this regard, a rotating antenna may be bothered by obstructions but not from holes in the pattern, for its raid rotation does not permit a radar signal to remain at an angle that hash poor pick up for more than a fraction of a second.

Another reason for being able to pick up a response better on one antenna than on another for the same band is due to antenna design. On the basis of design, superior results can be expected from the DBM-1 1000 Mc to 5000 Mc antenna, and from the TDY-1 antenna, when available, over its 90 Mc to 800 Mc coverage. It is known that both of these directional antennas have a high gain, in other words, they have good sensitivity. Likewise, it is known that the fixed antennas and the DBM-1 90 Mc to 1000 Mc antenna have low gain, so not as much can be expected from them.

The results that can be expected from any antenna is something that should be determined by extensive tests on each individual ship. A good many factors enter into the problem. The location of the antennas, in the clear and free of obstructions as much as possible, away from stack soot or anything that might cause rapid deterioration, careful installation of antennas and lead to the intercept room--all have an effect as to how well the receiver can pick up a distant radar signal. It is these same things that largely determine the upper frequency range of the waveguide antenna, whether it can go to 9000 Mc or even to 12000 Mc.

When the operator wishes to compare the results of different antennas used in the same band, such as comparing the two fixed with the rotating DMB-1, it is a good idea to make direct comparisons between them on the same radar signal, doing this as many times as possible on as many frequencies as signals can be picked up. A noticeable increase in signal strength or less tendency to fade are things to be noted as indications of an antenna's efficiency.

From the operator's standpoint, efficient searching of any band means trying first the antenna that is expected to give best results. If no enemy signal is detected in several tries over the dial, switch to another antenna for the same band and continue the search. Keep trying all possible antennas. Remember, one may pick up a response that cannot be heard on the others. Also, when a signal becomes weak or is difficult to analyze, the operator should always be ready to switch between the antennas to find the one that provides the best signal for measurement.

--6--

WAVE TRAPS

There are three wave traps in the search intercept system, the F-26/UPR in the antenna lead of the SPR-2 receiver, and the F-20/UPR and F-19/UPR in the antenna lead of the RDO receiver. The purpose of any of these wave traps is to provide a close estimate of the true frequency of a response tuned in on the receiver. Such an estimate will indicate whether the true frequency of the response can be read directly from the dial or is one of the other possible frequencies listed on the tuning chart.

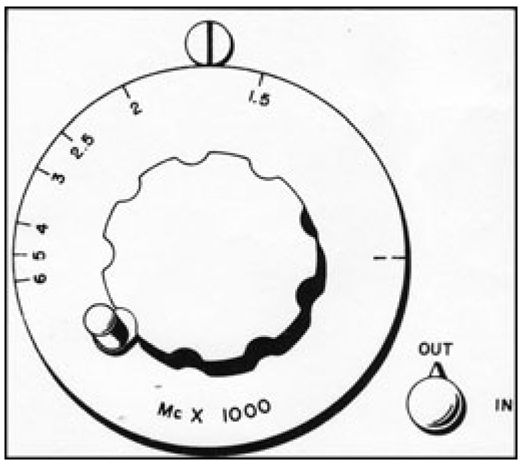
The only preliminary check that must be made of wave traps when getting the search system ready for operation is to make sure that each one is in the OUT position.

WAVE TRAP F-26/UPR

The F-26/UPR wave trap is used to check a response to determine whether or not the true frequency of the radar is at some point in the 1000 Mc to 6000 Mc range of the trap.

In the search system it is used entirely with the SPR-2 search receiver.

METHOD OF USING THE WAVETRAP

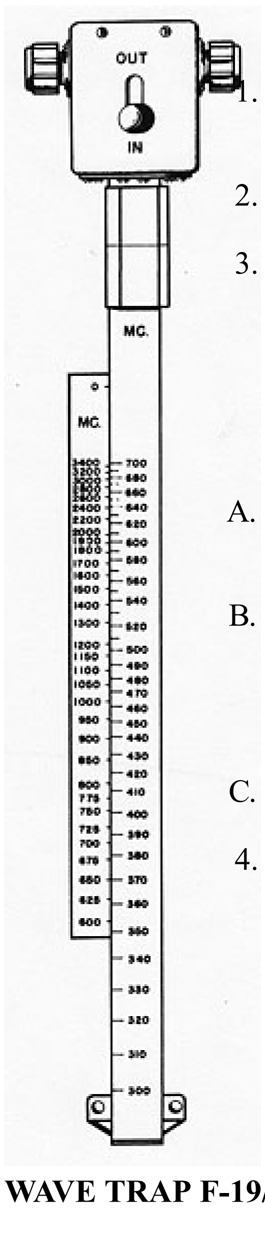


1. The response is tuned in on the search receiver in the usual manner, being heard in the headpohones, and appearing on the scopes of the other units.
2. To connect the wave trap into the circuit, turn switch knob slightly clockwise, push it in about half an inch, and then turn clockwise until it stops.
3. Always start tuning the F-26 wave trap from the high frequency (6000 Mc) end. Turn dial toward lower frequencies to try to find a null. A null can be detected in three different ways: (1) as a noticeable drop in volume in the phones, (2) as a decrease in the height of the pulse on the pulse analyzer scope, and (3) as a decrease in the height of the rails on the pan[oramic] adaptor scope (turning SWEEP control to 0 will make it easier to see the rails). If the null is broad, a finder adjustment can be made by advancing the receiver gain control and tuning the trap again.
   A. The dial reading of the first null found when tuning from a higher frequency end will give a close estimate of the frue frequency of the radar. Any other nulls found by tuning to lower frequencies should be disregarded.
   B. If no null is found, it indicates that the radar is operating at a frequency outside the range of the wave trap, usually below 1000 Mc.
4. To remove wave trap from the circuit, turn switch knob counterclockwise, pull out about half an inch, and turn counterclockwise until it stops. The wave trap must always be in OUT position while searching over the dial for radar signals.

WAVE TRAP F-20/UPR

The F-20/UPR wave trap is used to check a response to determine whether or not the true frequency of the radar is at some point in its 300 Mc to 3400 Mc range.

In the radar search system the F-20 is used entirely with the RDO radar search receiver. It provides a direct check for any response picked up on the TN-3B tuning unit (300 Mc to 1000 Mc dial)_. It also is the first wave trap used with the TN-1B and TN-2B tuning units to make sure that the true frequency of a response is not above 300 Mc.



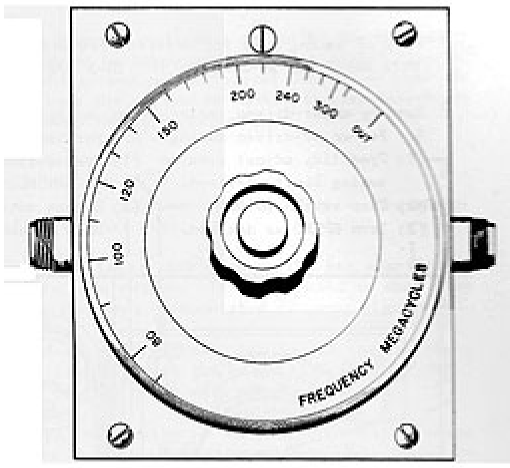
METHOD OF USING THE F-20 WAVE TRAP

1. The response is tuned in on the search receiver in the usual manner, being heard in the headphones, and appearing on the scopes of the other units.
2. Snap switch to IN to connect wave trap into the circuit.
3. Always start tuning the F-20 wave trap from the high frequency end, with slider all the way at the top, as close to the switch as possible. The moveable scale on the left (3400 down to 600) can be left in any position at first. Move the slider slowly down the main fixed scale to try to find a null. A null can be detected in three different ways: (1) as a noticeable drop in volume in the phones, (2) as a decrease in height of pulse on the pulse analyzer scope, and (3) as a decrease in height of rails on the pan adaptor scope (turning SWEEP control to 0 will make it easier to see the rails). If the null is broad, a finer adjustment can be made by advancing the receiver gain control and tuning the wave trap again.
   A. If the first null is found when the slider is at some point on the main scale (700 down to 300), a close estimate of the true frequency of the radar can be made by reading the setting directly under the center cross-line of the slider.
   B. If the first null is found when the slider is on the unmarked portion of the main scale, above 700, move the scale on the left (3400 down to 600) to make the 0- even with the center cross-line of the slider. Leave the left-hand scale in that position, and continue moving the slider down toward lower numbers. There will be a second null, at which point the frequency of the radar can be read from the left-hand scale at the center cross-line of the slider.
   C. If no null is found, it indicates that the radar is operating outside the range of the trap, usually below.
4. Always snap switch back to OUT after using the wave trap.

   Note: When an F-26/UPR wave trap is not available for the SPR-2 search receiver, the F-20 can be used with the SPR-2 as well as with the RDO, for the trap can check true frequencies up to 3400 Mc. If the F-20 is to be used with both receivers, it is suggested that the wave trap be put in the lead between the ANTENNA SWITCH and the ANTENNA JACK BOX, and the F-29 connected directly to the RDO. The operation of the F-20 will be the same for both receivers.

WAVE TRAP F-19/UPR

The F-19/UPR wave trap is used to check a response from a radar that is known to be operating within its range of 80 Mc to 300 Mc. As a preliminary to using the F-19, it is generally necessary to first check an unknown response with the F-20 (range 300 Mc to 3400 Mc) to make sure the radar is not operating above 300 Mc.



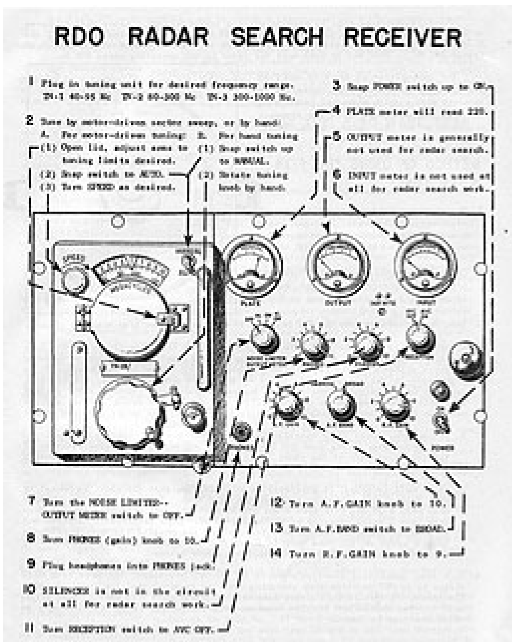
The combination of the F-19 and F-20 wave traps provides the RDO radar search receiver with a quick method of identifying the true signal frequency of any response picked up on any dial setting of the TN-1B, TN-2B, or TN-3B tuning units.

METHOD OF USING THE F-19 WAVE TRAP:

1. The response is tuned in on the search receiver in the usual manner, being heard in the headphones, and appearing on the scopes of the other units.
2. Check the response with the F-20 wave trap (see instructions on other page). If no null is found, proceed to F-19.
3. Turn dial clockwise from the OUT position to connect the wave trap into the circuit.
4. Always start tuning the F-19 wave trap from the low frequency (80 Mc) end. Turn the dial to higher frequencies slowly to try to find a null. A null can be detected in three different ways: (1) as a noticeable drop in volume in the phones, (2) as a decrease in the height of the pulse on the pulse analyzer scope, and (3) ass a decrease in the height of the rails on the pan adaptor scope (turning SWEEP control to 0 will make it easier to see the rails). If the null is broad, a finer adjustment can be made by advancing the receiver gain control and tuning the trap again.
   A. For a radar known to be operating below 300 Mc, the dial reading of the first null found when tuning from the low frequency end will give a close estimate of the true frequency of the radar. Any other nulls that may be found by tuning to higher frequencies should be disregarded.
   B. If no null is found, it generally is an indication that the radar is operating at s frequency outside the range of the wave trap. It is not likely to happen when both F-20 and F-19 wave traps are used on the same response, for together they have a total coverage of 80 Mc to 3400 Mc. If a response is detected and no null is found on either wave trap, check the possibility that a response from a radar on the same ship is being picked up through the power lines of some other way than through the regular antenna system.
5. Turn dial completely counterclockwise to the OUT position. The wave trap must always be in OUT position when searching over the receiver dial for radar signals. The reason for this is that a wave trap left in the circuit will make it more difficult or even impossible for the receiver to pick up signals at the frequency to which the trap is tuned.

--9--

RDO RADAR SEARCH RECEIVER



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EXPLANATION OF STEPS AND CONTROLS USED IN OPERATING THE RDO

1. Three interchangeable plug-in tuning units are supplied with each RDO. A 4th unit covering 1000 Mc to 3400 Mc is not standard equipment, for its function is taken over by the SPR-2 receiver. Units can be quickly interchanged by unscrewing the catch at the lower right of the unit and slipping one out and and another into place.
2. For general search work trying to locate enemy signals on a sector of the dial where few or no signals are heard, but which has to be tuned until an enemy signal appears, the operator can use the motor-driven tuning, and set the sector limits, so that the tuner automatically goes back and forth over the section he wishes to keep searching. For all ordinary search work, manual or hand tuning is preferred.
3. The POWER switch turns the RDO receiver on and off.
4. When the PLATE meter does not read the normal 220, or near that figure, the attention of the technician should be called to that fact.
5. The OUTPUT meter is not used very much for radar work because the pan adaptor and pulse analyzer scopes give more valuable information. It can be used to show when a signal is tuned in. Its main value is for phone or modulated cw (mcw) signals.
6. The INPUT meter is not intended for use on radar signals, but is for reading phone or mcw signals. The adjustment to the lower left of the meter, labelled INP.MTR., is for setting the INPUT meter pointer exactly on 0, with no signal input.
7. NOISE LIMITER--OUTPUT METER switch serves two functions. When on NL it puts a noise limiter circuit into operation to reduce the volume of strong interfering noises to enable weak modulated signals to be heard better. When on OM it puts the output meter into the circuit

for observing the strength of signals on the OUTPUT meter. Both functions can be put into use at the same time by NL--OM. The noise limiter must not be used for radar search as it reduces the volume of a signal in the phones.

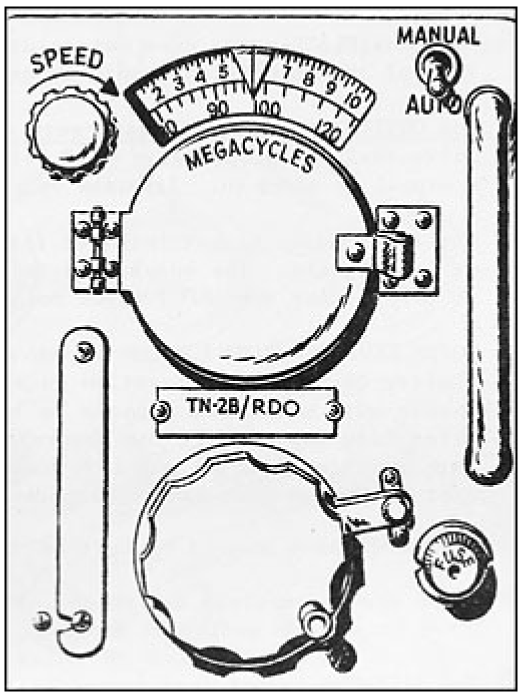
8. The PHONES knob should be left on full, and volume adjustments made with R.F. GAIN.
9. There are two outlets for phones. The one on the panel is the one ordinarily used. There is also an outlet on the back to connect to phones or speaker-amplifier units.
10. The SILENCER is not used for radar search work. It is for phone and mcw reception. When it is in the circuit, it should be turned to 0 for reception of weak signals, for the more it is turned up, the stronger a signal has to be in order to be heard.
11. For radar search, the RECEPTION switch must be on AVC OFF. For reception of phone or mcw signals, it can be turned to AVC ON, which provides automatic volume control, puts the SILENCER into the circuit, shorts out the R.F. GAIN control, and connects the INPUT meter into the circuit.
12. The A.F. GAIN knob control audio volume only. With the OUTPUT meter in the circuit, the A.F. GAIN is used to control the reading. It does not affect the pictures on the scopes of the panoramic adaptor or the pulse analyzer. It is usually left on full.
13. The A.F. BAND is left on BROAD for radar work. On a phone or mcw signal, it may be switch to NARROW to try to limit interference from noise or other signals.
14. The R.F. GAIN knob provides in one control a means of adjusting the gain of the search receiver to obtain the headphone volume needed to hear weak signals, to get the presentation on the pulse analyzer scope needed for accurate measurements, or to get patterns on the direction finder scope that give true bearing readings.

--11--

TUNING UNITS FOR RDO RADAR SEARCH RECEIVER

The tuning in of a radar response and the determining of its frequency, centers about the tuning unit of the search receiver. The other units of the search system, such as wavetraps and panoramic adaptor, can give additional information to check the frequency of the radar signal, but the tuning dial always is the starting point.

So far as results are concerned, the tuning units provided with the RDO do the same job as the older ones used with the SPR-1 and APR-1 receivers. The TN-1B, TN-2B, and TN-3B tuning heads are interchangeable with the TN-1, TN-2, and TN-3 heads that have been in use with the SPR-1 and APR-1 for some time.



The complete list of tuning units that are interchangeable, or can easily be made to be interchangeable, is as follows:

RDO	SPR-1	APR-1	Others
TN-1B	TN-1	TN-16	TU-56
TN-2B	TN-2	TN-17	TU-57
TN-3B	TN-3	TN-18	TU-58

The main difference is that the newer "B" tuning units have a motor-driven sector sweep, easily adjusted so that any portion of the band can be automatically searched without touching the unit once it is started.

Each TN tuning unit is designed to pick up radar signals over a certain range of frequencies, and each dial is marked accordingly. It will detect radar signals whose frequencies can be read directly from the dial. It will also pick up responses from radars whose frequencies CANNOT be read directly from the dial. There are two reasons for such additional responses:

1. The responses that can be tuned in on any tuning head are not limited to the frequency range marked on the dial. Each tuner can detect signals from radars operating at higher frequencies, and sometimes at lower frequencies, than is indicated by the dial markings.
2. The design of this type of tuning unit makes it likely that many radar signals, especially the stronger ones, will appear on the dial as pairs of responses, usually spaced 60 Mc or less apart. For each pair, one of the two responses is used as a starting point to figure the frequency of a radar.

Because of the number of possible responses that may be tuned in on the dial, it is absolutely necessary to make a check on any unknown response tuned in. This check is made easier by having in mind the information already learned about the enemy radars--their frequencies and pulse repetition rates. It provides a head start to identifying a response as a radar on a certain frequency.

--12--

The type-allowance radar search system employs several methods for checking the frequency of any response:

1. The quickest and simplest check to find the true frequency of any response is by means of a wavetrap.
2. The response as it appears on the scope of the panoramic adaptor will give information that will help determine the true frequency of the radar:
   a. The direction the response moves across the scope as the dial is rotated counterclockwise, from lower to higher frequencies, provides an absolutely certain method of telling which response of a pair is the one that can be used as a starting point for figuring frequency. The direction is not the same for all three tuning units, so each one is treated individually.
   b. The speed at which the response moves across the scope when the tuning dial is moved at a constant rate of speed provides a definite clue as to what band the radar is probably operating. Responses that are within the dial markings, as a general rule, move considerably slower than do responses from radars operating at higher frequencies. (The TN-3 has an exception to the rule).
   c. A true frequency can be identified by seeing it move 10 Mc across the scope while the dial is being moved 10 Mc according to the dial markings. This is sometimes difficult lto do when the response is weak or for any reason is hard to follow across the pan adaptor scope.

Full information about the wavetrap and pan adaptor methods of determining the radar frequency is given in the instructions for those units of the search system.

To aid the operator to understand what the most likely frequencies are for any response tuned in on the dial, a chart has been made for each tuning unit. The chart is especially valuable when the wavetrap and pan adaptor methods are not available, for the separation between a pair of responses from the same radar will provide a way of figuring the frequency of the radar. Each chart is a guide to help the operator determine the true frequency of any response, and in many instances a change in tuning heads and tuning to a higher frequency can be made to check a possible frequency.

The frequencies shown on the charts are the most likely ones, but are not the only possibilities. A distant radar signal, such as from an enemy radar, will very probably be the frequency as indicated by the dial reading or one of the other possible frequencies listed directly under the dial reading on the tuning unit chart. For strong, local radars, on the same or a nearby ship, the possible responses are too numerous to mention. These can be recognized quickly by an experienced operator by checking the pulse rate, and a minimum amount of time will be spent on them. Whenever possible, it pays to log them ahead of time by marking them in pencil on the top scale of the chart for the tuning unit in use.

It is recommended that the operator thoroughly master the method of operation given for the TN-1B and the TN-2B tuning units, for the same method applies to both of those units of the RDO, and also to the tuning unit of the SPR-2 search receiver. The TN-3B tuner must be considered as an exception to the general operating method.

--13--

TN-1B TUNING UNIT

Designed for reception of radar signals:

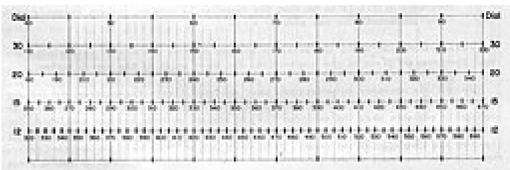
40 Mc to 95 Mc

True frequency of a response of a radar signal may be checked by:

1. Wavetrap F19, between 80 Mc and 95 Mc. There is no wavetrap in the search system for use below 80 Mc.

2. On the panoramic adaptor, the main response will be the upper or higher frequency one, and it will move from right to left (**<---**) across the pan adaptor scope when the dial is rotated counterclockwise from lower to higher frequencies. The pan adaptor can also help to determine the true frequency by showing the speed with which a response moves across the scope, and by the number of dial divisions required to move the signal 10 Mc across the face of the scope.

3. Chart of the most likely radar frequencies for a response tuned in on the TN-1B:
   The following chart will provide a method of finding the frequency of a radar more rapidly after a main response, "upper" for the TN-1B head, has been located on the dial. For example, a response is found on 85, and the pan adaptor proves it is the main response by the direction it moves across the scope, thus providing a starting point to figure the frequency. To use the chart, find 85 on the top line, same as the dial, and note that 85 Mc, 200 Mc, 315 Mc, 430 Mc, and 545 Mc are possible frequencies. (The scale is numbered in 10 Mc steps for easy reading).



DIAL READINGS	**METHOD OF READING THE CHART AND FIGURING THE RADAR FREQUENCY WHEN A PAIR OF RESPONSES FROM THE SAME RADAR ARE TUNED IN**	**FREQUENCY**
55 & 85	When a pair of responses from the same radar are 30 Mc apart, read upper response, follow down to 2nd line, marked 30. To calculate: upper response on dial × 2 + 30 = frequency.	200 Mc
70 & 90	When 20 Mc apart, read upper response, follow down to 3rd line. To calculate: upper response on dial × 3 + 60 = frequency.	330 Mc
38 & 53	When 15 Mc apart, read upper response, follow down to 4th line. To calculate: upper response on dial × 4 + 90 = frequency.	302 Mc
62 & 74	When 12 Mc apart, read upper response, follow down to 5th line. To calculate: upper response on dial × 5 + 120 = frequency.	490 Mc
Note:	A pair of responses from the same radar 60 Mc apart cannot be tuned in on the TN-1B dial, as it is only 55 Mc wide. Other responses from radars operating at even higher frequencies will generally be too weak to be heard, unless they are strong local signals.	

--14--

TN-2B TUNING UNIT

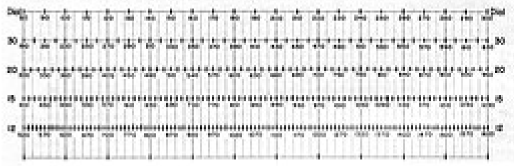
80 Mc to 300 Mc.

True frequency of a response of a radar signal may be checked by:

1. Wavetrap F19, between 80 Mc and 300 Mc, the full range of the trap.

2. On the panoramic adaptor, the main response will be the upper or higher frequency one, and it will move from right to left (**<---**) across the pan adaptor scope when the dial is rotated counterclockwise from lower to higher frequencies. The pan adaptor can also help to determine the true frequency by showing the speed with which a response moves across the scope, and by the number of dial divisions required to move the signal 10 Mc across the face of the scope.

3. Chart of the most likely radar frequencies for a response tuned in on the TN-2B: The following chart will provide a method of finding the frequency of a radar more rapidly after a main response, "upper" for the TN-2B head, has been located on the dial. For example, a response is found on 150, and the pan adaptor proves it is the main response by the direction it moves across the scope, thus providing a starting point to figure the frequency. To use the chart, find 150 on the top line, same as the dial, and note that 150 Mc, 330 Mc, 510 Mc, 690 Mc, and 870 Mc are possible frequencies. (The scale is marked in 10 Mc steps for easy reading).



DIAL READINGS	METHOD OF READING THE CHART AND FIGURING THE RADAR FREQUENCY WHEN A PAIR OF RESPONSES FROM THE SAME RADAR ARE TUNED IN	FREQUENCY
130 & 190	When a pair of responses from the same radar are 60 Mc apart, read upper response on the dial. It is direct reading. The dial has markings corresponding to those on the top line.	190 Mc
220 & 250	When 30Mc apart, read upper response, follow down to "30" line. To calculate: upper response on dial × 2 + 30 = frequency.	530 Mc
280 & 300	When 20 Mc apart, read upper response, follow down to "20" line. To calculate: upper response on dial × 3 + 60 = frequency.	960 Mc
85 & 100	When 15 Mc apart, read upper response, follow down to "15" line. To calculate: upper response on dial × 4 + 90 = frequency.	490 Mc
108 & 120	When 12 Mc apart, read upper response, follow down to "12" line. To calculate: upper response on dial × 5 + 120 = frequency.	720 Mc
Note:	This chart should prove adequate for figuring frequencies of enemy radar signals. Pairs of responses other than those that can be read from the chart are almost always caused by strong local signals.	

--15--

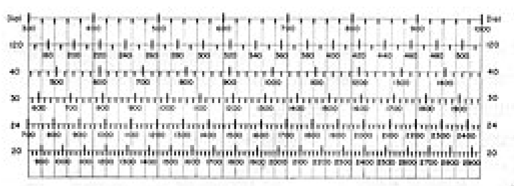
TN-3B TUNING UNIT

Designed for reception of radar signals:

300 Mc to 1000 Mc

True frequency of a response of a radar signal may be checked by:

1. Wave trap F20, between 300 Mc and 1000 Mc.
2. On the panoramic adaptor, the main response will be the lower frequency one, and it will move from left to right (**--->**) across the pan adaptor scope when the dial is rotated counterclockwise from lower to higher frequencies. The pan adaptor can also help to determine the true frequency by showing the speed with which a response moves across the scope, and by the number of dial divisions required to move the signal 10 Mc across the face of the scope.
3. Chart of the most likely radar frequencies for a response tuned in on the TN-3B:
The following chart will provide a method of finding the frequency of a radar more rapidly after a main response, "lower" frequency for the TN-3B head, has been located on the dial. For example, a response is found on 7009, and the pan adaptor proves it is the main response by the direction it moves across the scope, thus providing a starting point to figure the frequency,. To use the chart, find 700 on the top (DIAL) line, and note that 365, 700, 1035, 1370, 1705, and 2040 are possible frequencies.



DIAL READINGS	METHOD OF READING THE CHART AND FIGURING THE RADAR FREQUENCY WHEN A PAIR OF RESPONSES FROM THE SAME RADAR ARE TUNED IN	FREQUENCY
360 & 480	When a pair of responses from the same radar are 120 Mc apart, read lower response on the dial, follow down to the "120" line. To calculate: lower response on dial × ½ + 15 = frequency.	195 Mc
700 & 760	When 60 Mc apart, read lower response. Dial is direct reading. No calculation is necessary. Both DIAL and "60" are the same.	700 Mc
650 & 690	When 40 Mc apart, read lower response, follow down to "40" line. To calculate: lower response on dial × 1½ - 15 = frequency.	960 Mc
500 & 530	When 30 Mc apart, read loser response, follow down to "30" line. To calculate: lower response on dial × 2 - 30 = frequency.	970 Mc
620 & 644	When 24 Mc apart, read lower response, follow down to "24" line. To calculate: lower response on dial × 2½ - 45 = frequency.	1505 Mc
340 & 360	When 20 Mc apart, read lower response, follow down to "20" line. To calculate: lower response on dial × 3 - 60 = frequency.	960 Mc

--16--

THE EXPERT'S METHOD OF OPERATING THE TUNING UNITS

The difference between a beginning operator and the experienced radar intercept man is that the beginner has to stop and think what he is doing--what control he must use and what to do next--what the response is that he hears in the phones and sees on the different scopes, whereas, the experienced operator almost automatically turns the right control as he listens to the sounds in the phones and watches the patterns on the scopes for certain characteristics that identify the response as friend or enemy.

The really good operators of intercept gear have certain common methods, plus a lot of information about frequencies, pulse rates, etc., of both friendly and enemy radars that they carry around in their heads. It is a fairly easy job to learn the methods of the experts; it takes a good amount of memorization to learn the facts about the friendly and enemy radars that might be tuned in; and it takes a lot of practice to do the whole job smoothly with ease and sureness.

The expert has a definite method of tuning. it is to turn the dial counterclockwise at a smooth even speed for all the tuning units. The search over any band usually begins by tuning from the lower frequencies to the higher ones. When a signal is tuned in, it is analyzed by tuning from the lower frequency to the higher frequency side.

This technique of tuning gives the experienced operator much of the information he needs when he tunes in a response. This is what it does:

1. Tuning the dial counterclockwise to tune from the lower to the higher frequency side of a response while watching the response on the pan adaptor scope positively identifies it as a main response. (A main response is the starting point for determining the true frequency of a radar signal). For the TN-1B and TN-2B tuning units the main response can be recognized by the fact that it moves from right to left (**<---**) across the pan adaptor scope, while for the TN-3B it moves in the opposite direction, from left to right (**--->**). It save time in searching to ignore responses that move in the opposite direction to the main responses, for such "opposite" responses are weaker and harder to analyze, do not give information that cannot be obtained better from the main responses, and usually are from strong local radar signals. It pays to concentrate attention on main responses.
2. Tuning the dial at an even speed gives the operator a chance to pick out on the pan adaptor scope those responses whose frequencies can be read directly from the tuning dial. Such responses can be recognized fairly easily on the TN-1B and TN-2B tuning units by the ordinary speed that they move across the pan adaptor scope, in contrast to the other responses that move noticeably faster. It takes more skill to identify a "dial" response on the TN-3B tuner, for the operator not only has the problem of picking out a response of ordinary speed from the ones that move noticeably faster (the same as with the TN-1B and the TN-2B) but also from some very slow moving ones (120 Mc pairs) and some that are slightly faster (40 Mc pairs).

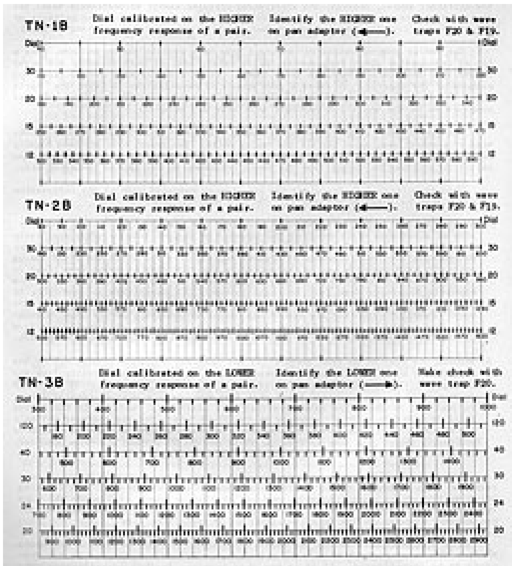
The experienced operator does many things at the same time when he tunes in a response. His method of tuning gives him a response that can be used as a starting point to figure the true frequency, and has also given him a clue as to the true radar frequency. The tone of the response in the phones, and its appearance on the pan adaptor scope helps him to estimate the pulse repetition rate.

With that much information the experienced intercept man is able to determine whether the response is from a local radar, from a friendly radar, or is one that needs to be investigated. If it is one that requires further investigation, the operators' estimate of the true frequency can be checked with the wave traps. They give a close estimate of the radar's frequency that can be compared with the tuning dial and the tuning charts for more exact information. His guess as to the pulse repetition rate can be checked by the pulse analyzer to obtain more accurate PRR and also pulse width measurements.

--17--

SUMMARY OF THE TUNING CHARTS

The following three tuning charts can be used equally well with the RDO, the older Shipborne SPR-1, and the airborne APR-1 because the tuning units used for all of these search receivers are basically the same.



The chart method of presentation has been chosen in preference to any other method, including the tuning curves that have been in use, because each chart presents the information the operator needs for determining the true frequency of any enemy signal in a concise form that can be read quickly and accurately.

--18--

WAYS TO USE THE TUNING CHARTS

The operator who keep the tuning chart before him for any tuning unit he is using will find that it saves time and greatly simplifies the problem of determining the true frequency of any response tuned in on the dial. Such a chart provides a quick reference, showing the dial reading of the response, and the other most-likely true frequencies directly below it.

The ordinary way of using a chart is as follows: (1) a response is tuned in, and the direction it moves on the pan adaptor scope identifies it as a main response, thus providing a dial reading that can be used as the starting point for determining the true frequency, (2) if the speed of the response as it moves across the pan adaptor scope gives a clue as to true frequency, the estimate is checked against the chart, (3) the proper wave trap is then used to get a close estimate of true frequency, and (4) the wave trap estimate is compared with the chart.

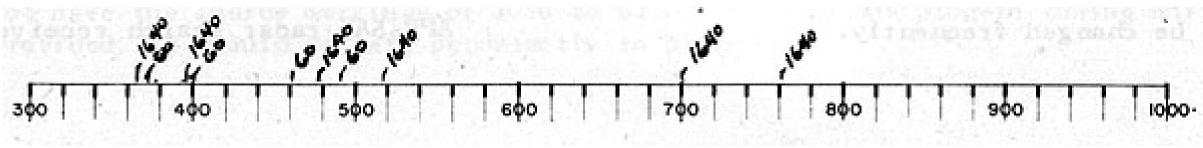
An example will show how this works. A response is picked up at 360 on the dial of the TN-3B tuner. It is not immediately recognized as a known response, so its direction and speed is checked on the pan adaptor scope. It is a main response, but its speed is difficult lto determine other than it is faster than responses that can be read directly from the dial. A quick look at the chart shows that 525, 690, 855, and 1020 are the most-likely true frequencies. A direct check could be made by tuning to 525, 690, or 855, but it takes only seconds to snap the F-20 wave trap ON, move the slider down until a null is found at 695 Mc, and then snap it OFF. the 695 Mc figure checks with the 690 Mc on the chart. A further check is made by tuning to about 690 to 700 Mc on the dial, where the same signal is found at 693 Mc with increased volume. Some differences of readings are to be expected due to the fact that dials and wave traps are closely though not precisely calibrated.

Another way of using a chart is to start with a known radar frequency and locate the places on the dial where a response from it is most likely to be picked up. It is in effect using the chart in reverse from the ordinary method. Its value is that it helps to show why responses from one radar signal can appear in so many places on the dial. An example will illustrate the method:

The know radar frequency is 500 Mc, and the problem is to locate the places on the dial of the TN-3B tuning unit that it might be heard. Start with the first or "Dial" line of the chart. The signal falls within the dial range so it can be heard at 500 on the dial. Read across the second or "120" line of the chart. Note that the 500 point can be followed up to 970 on the dial. Read across the next or "40" line. The 500 point can be followed up to 343 on the dial. A quick glance at the other lines shows that there are no other 500 points marked on the scales. The result is that the main response of a 500 Mc signal (the lower one for the TN-3B) should be heard at 500, at 970, and at 343 on the TN-3B dial.

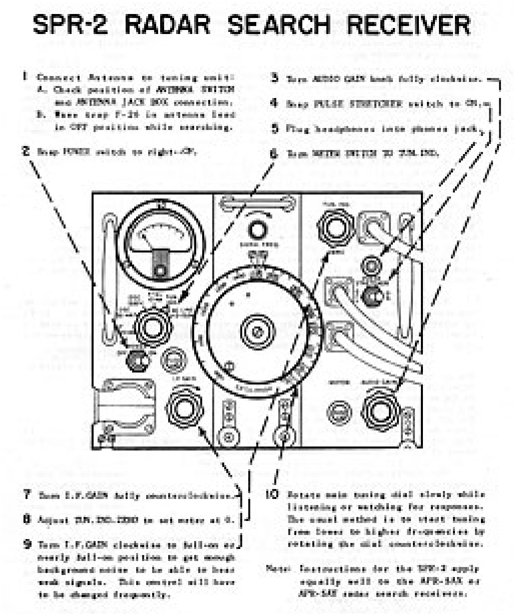
The charts are not designed to show all possible true frequencies for every response that is tuned in. They are made for use with enemy radar signals, which are picked up at sufficient distance that only a limited number of responses will be heard on the dial. They are not made to explain why strong local radar signals, particularly those on the same ship, can be heard so many places on the dial.

The most practical way to handle the problem of responses from local radars is to forget the calculations, and instead tune over the dial at the beginning of a search watch, carefully logging all the responses that can be heard. The handiest way to log such responses is to make a line similar to the "Dial" line of the tuning chart, and then mark the places on it in pencil, indicated the PRR of each response.



--19--

SPR-2 RADAR SEARCH RECEIVER



--20--

EXPLANATION OF STEPS AND CONTROLS USED WITH THE SPR-2

1. The SPR-2 search receiver is designed for radar intercept work above 1000 Mc. Its ability to pick up responses from radars depends primarily on the choice of antenna for the frequency range to be searched. Three antennas (two fixed and one rotating DBM-1) are provided for 1000 Mc to 5000 Mc reception. A special waveguide antenna which starts at 3100 Mc and goes to higher frequencies can be used. Its upper limit depends mainly on the way it is installed and the strength of signal. The usual method of changing from one antenna to another is by means of the ANTENNA SWITCH; however, if such a switch is not in use, the SPR-2 lead must be plugged into different antenna outlets on the ANTENNA JACK BOX.

2. After the POWER switch has been snapped to ON, it takes about 30 seconds for the receiver to start operating, and about 10 minutes for it to be fully warmed up.

3. The AUDIO GAIN knob controls the amount of volume in the headphones. Its main value is that it can be used to reduce a loud signal to comfortable headphone volume without changing the presentation on the scopes of the other units. In actual operation it is usually left on full, with gain controlled by the I.F.GAIN.

4. The PULSE STRETCHER switch is left in ON position for all ordinary operations. It makes it possible to hear signals of such short pulse lengths that they would not be heard with the switch off. While there may be some pulses of such long duration that they can be heard better with the switch off, even those can be heard satisfactorily with the switch in ON position. Whether off or on, this switch has little effect on the pulse as seen on the scope of the pulse analyzer.

5. The only phones jack is the one provided on the front panel.

6. The METER SWITCH shifts the one meter into different circuits. To check the operation of the set at the beginning of a search watch, the following should be done:

   A. Turn to AC LINE 0-150. Meter should read about .77 (115 volts).
   B. Turn to XTAL 10 MA. Meter should read between .02 and .6 (6 ms).
   C. Turn to OSC 500 V. Rotate main tuning dial over the entire scale. Readings should be between .2 and .6 (100 to 300 volts) and should never exceed .6 at any point. The technician should adjust the set if it does.
   D. Turn to OSC 50 MA. The meter should read about .3 (15 ms).
   E. Turn to IF 100 MA. Then adjust I.F.GAIN knob to get a meter reading of .6, a point which is considered normal for beginning operation.
   F. Turn to TUN.IND position when searching for a radar signal. It connects the meter into the circuit to show when any radar signal is tuned in. The operator will find that it is better to watch the scopes of the pan adaptor and the pulse analyzer than to watch the response on the SPR-2 meter.

7. & 9. The I.F.GAIN control is the most important means of controlling the presentation of the radar response on the scopes of the pan adaptor, pulse analyzer, and direction finder; of obtaining correct readings from the PRR meter on the pulse analyzer; and for regulating the amount of volume in the headphones. Generally the gain controls on pan adaptor, pulse analyzer, and direction finders are left well advanced, and all gain adjustments made with the I.F.GAIN of the SPR-2.

8. The TUN.IND.ZERO knob needs to be used only once at the start of a search watch.

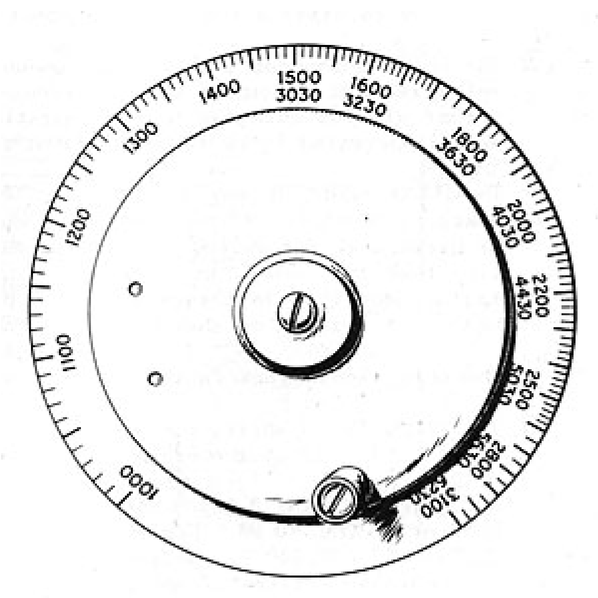
10. The receiver has one-dial tuning, and a plug-in tuning unit. The dial may or may not have the inside markings of 3030 to 6230. As only one plug-in tuning unit is provided, it should be left permanently in place.

--21--

TUNING OVER THE DIAL. FIGURING OUT WHAT IS RECEIVED.

After the SPR-2 (APR-5AX) has been turned on according to the instructions, start to search for radar signals by rotating the main tuning control and leave all the other adjustments temporarily as they are.

At first glance it would appear that the frequency of anything heard could be read directly from the dial, especially for the 1000 mc to 3100 mc markings. Tuning once over the dial, when a number of radars are operating, is enough to convince anyone that all the responses are not all from different radars, for too many of them sound exactly alike. The problem is one of identifying responses.



The following will happen when a radar signal of medium strength on 3100 mc hits the cone antenna, which passes the energy down the antenna lead to the receiver.

In tuning from the 3100 mc end of the dial, the radar is found near but not exactly on the 3100 mark. It makes one aware of the fact that the dial markings are approximate. Another response of the same strength and tone is found at about 3040, exactly 60 mc lower in frequency.

In tuning down the dial the same radar signal shows up again at about 1540, and at about 1510, 30 mc apart.

A similar response appears at about 1020, and again at about 1000, 20 mc apart.

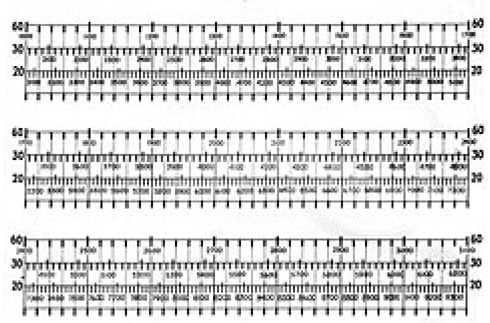
This example illustrates the important things to know to operate the SPR-2.

1. Responses from the same signal will be found in pairs on the dial, 60 mc, 30 mc, and 20 mc apart, and this fact provides the basis of determining the radar frequency.
2. The upper response of a pair 60 mc apart is the actual radar frequency, and can be read directly from the outer dial.
3. The upper response of a pair 30 mc apart is about half the actual radar frequency. It can be calculated by multiplying the outer dial setting by 2 and adding 30.
4. The upper response of a pair 20 mc apart is about one-third the actual frequency. It can be calculated by multiplying the outer dial setting by 3 and adding 60.
5. Pairs of responses from any one signal might appear at several places on the dial, and any pair can be used to figure the frequency; however, when possible find the 60 mc pair to get direct reading from the dial (and somewhat stronger responses).

--22--

SPR-21 CHART FOR FIGURING THE FREQUENCY OF A RADAR

The following chart will provide a method of finding the frequency of a radar more rapidly after an "upper" response has been located on the dial. For example a response is found on 1100, and the panoramic adaptor proves it is an upper one by the direction it moves across the scope. To use the chart, find 1100 on the top line, and not that 1100 mc, 2230 mc, and 3360 mc are possible frequencies. (The chart is made in 20 mc steps for easy reading). Then turn the tuning control to find a lower response that pairs with the upper one. It should appear at a point 60 mc, 30 mc, or 20 mc lower on the outer dial. The one found will tell the line to read on the chart.

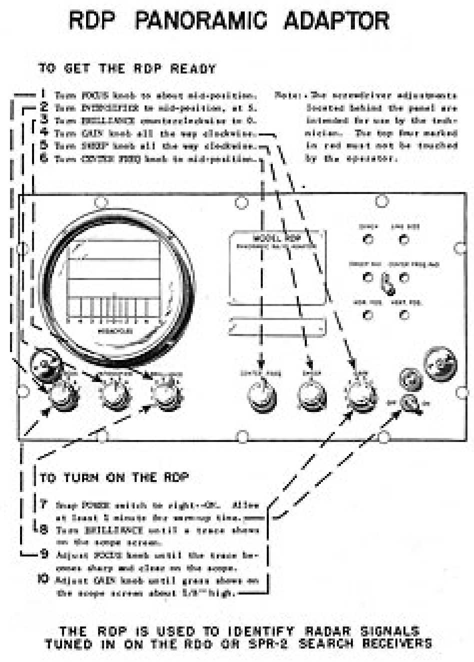


OUTER DIAL READINGS	--EXAMPLES-- METHOD OF READING AND FIGURING THE RADAR FREQUENCY	RADAR FREQUENCY
2840 & 2900	When a pair of responses from the same radar are 60 mc apart, read the upper response on the outer dial. It is direct reading. The outer dial has the same markings as the 1st line of scale.	2900 Mc
1500 & 1530	When 30 mc apart, read upper response, follow down to 2nd line. It is easier to read than trying to read the inner dial scale. To calculate: upper response, outer dial × 2 + 30 = frequency.	3090 Mc
1020 & 1040	When 20 mc apart, read upper response, follow down to 3rd line. TO calculate:upper response, outer dial × 3 + 60 = frequency.	3180 Mc

There may be other pairs, usually weak one, such as 15 mc (upper dial response read × 4 + 90 = frequency), but in ordinary situations it pays to concentrate on searching for pairs of responses 60 mc, 30 mc, and 20 mc apart. When all of those have been found and identified, it is time to try to figure out the odd pairs.

--23--

RDP PANORAMIC ADAPTOR



THE RDP IS USED TO IDENTIFY RADAR SIGNALS
TUNED IN ON THE RDO OR SPR-2 SEARCH RECEIVERS

--24--

EXPLANATION OF STEPS AND CONTROL USED WITH THE RDP

1. & 9 The FOCUS knob is one of the three controls on the panel that are used to get a clear and sharp picture on the scope screen. A final adjustment on it can be made after a signal has been tuned in and shows on the scope.

2. The INTENSIFIER knob can be left at 5 for all ordinary operating. Its function is to make brighter any pulse signals that appear on the scope.

3. The BRILLIANCE knob controls the intensity of the picture on the scope, in fact, on many units having scope tubes it is marked "INTENSITY". It should never be turned up any farther than is necessary to see a distinct picture on the scope screen, for too bright a trace injures the surface of the scope tube.

4. The GAIN knob is the most used control on the RDP. When the RDP is used with the RDO receiver, the GAIN knob is the only control that affects the amplitude of the signal as it appears on the scope screen, and the GAIN normally will be nearly on full, about 9. When the RDP is used with the SPR-2 receiver, it is an entirely different operating procedure,k for best results will be obtained if the GAIN knob of the RDP is left at about 9, and the amplitude of the signal as it appears on the scope screen regulated by turning the I.F.GAIN control on the SPR-2 receiver.

5. The SWEEP knob (called SWEEP WIDTH FACTOR on other pan adaptors) is usually left all the way clockwise when searching for radar signals in order to get the full 10 Mc presentation on the scope screen. Some signals, however, such as those with low pulse repetition rates, may be heard in the headphones and still not be seen very well on the scope. Turning the SWEEP knob counterclockwise to mid-position (or even less) will make such signals much easier to see. The reason for this is that it distributes a small number of Mcs, for example, 5 Mc, over the full width of the scale.

6. The CENTER FREQ knob is used occasionally to make minor adjustments to move a signal that has been tuned in carefully on the receiver. Ordinarily there will be no need to touch it if it has been set correctly at the beginning of a search watch by the following method:

   A. Tune in on the receiver a radar signal with a fairly high pulse repetition rate so that it is loudest in the phones, or with the RDO so that it shows maximum on the OUTPUT meter.

   B. Turn SWEEP knob all the way counterclockwise, back to normal operating position.

   C. Adjust the CENTER FREQ knob to get the maximum height of signal on the scope. (It may be necessary to reduce the GAIN control somewhat at this point).

   D. Turn SWEEP knob all the way clockwise, back to normal operating position.

   E. With a screwdriver, turn HOR.POS. adjustment (behind the right side of the panel) to move the signal to the center "0" line of the pan adaptor scope screen.

7. The POWER switch turns the RDP on and off. While traces or signals may appear in about 20 seconds, and steady down pretty well in about a minute, it is best to let the unit warm up about 15 minutes before regular operation.

Note: The four screwdriver adjustments located behind the upper right side of the panel, marked SYNCH, LINE SIZE, SWEEP PAD, and CENTER FREQ PAD, are marked in red to warn the operator not to touch them. It takes a skilled technician with special signal generator equipment not found aboard ship to line these four control up to get best results with the pan adaptor. If necessary, the operator can adjust the HOR.POS control, which moves the trace to right or left, or the VERT.POS. control, which moves the trace up or down on the scope.

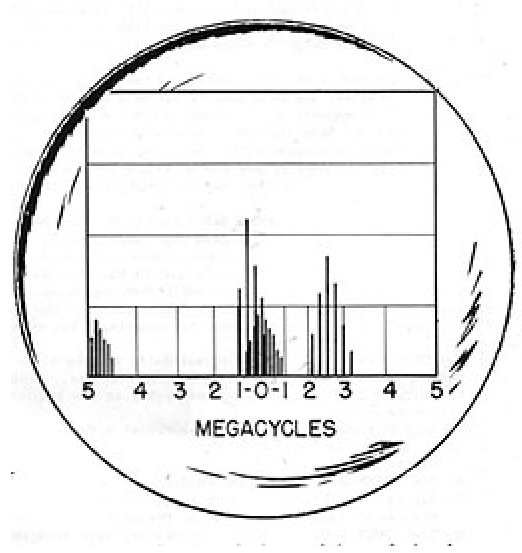
--25--

INFORMATION THAT CAN BE OBTAINED FROM A PANORAMIC ADAPTOR

1. This unit of the search system is designed to present a panoramic picture consisting of a 10 Mc portion of any part of the frequency band that is tuned in on one of the search receivers. The was that it is done is as follows:

   When a radar response is heard in the headphones of the radar search receiver, the same response will appear as thin vertical rails 0on the scope of the pan adaptor. With proper alignment a signal will be at the center (0) line of the scope screen when it is tuned to maximum in the phones or on the receiver signal-strength meter.

   The scope not only shows the signal that is heard in the phones, but also a general picture of everything received 5 Mc above and 5 Mc below what is heard.



The advantages of such a 10 Mc presentation is that the eye is able to see much more than can be heard in the phones, and is able to see identifying characteristics of signals that the ear cannot readily discern.

The wide visual presentation of the panoramic adaptor scope make it possible to recognize certain differences of the signals that appear on the scope screen. These are as follows:

1. Differences of frequency can be seen by the relative positions of signals on the baseline of the scope screen. It is hardly likely that any two radar signals would have so precisely the same frequency that some variation could not be seen even though they are almost on the same spot on the screen.
2. Differences of pulse repetition rate (PRR) can be roughly estimated by observing the general appearance of the signal on the scope. The higher the PRR, the close the rails will be, in fact a low pulse rate, 60 cycles, will appear as two wide-spaced rails, whereas one of a high rate, such as 3000 cycles, will have a closely-spaced bell-shaped pattern.
3. Differences of signal strength can be noted by the height of a signal on the screen. One way of recognizing two signals on the same frequency would be by variations in height of rails on the scope screen.

--*26*--

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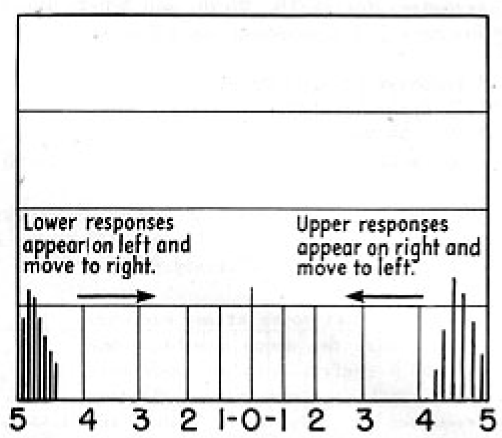
2. The panoramic adaptor provides a quick and certain method of determining whether a response is an upper (higher response) or a lower (lower frequency) one. This is done by observing the direction of the movement of any response across the scope as the receiver dial is turned.

As responses from any radar signal are considered in pairs, each receiver tuning unit uses either the upper or the lower of the pair for calibrating the tuning dial. What is needed is some quick means of identifying the one response of a pair that can be used as a starting point for determining the true frequency. A glance at the response as it appears on the pan adaptor scope give this information instantly.



Regardless of the method of tuning when search for signals, each response should be analyzed by tuning from the lower frequency side of it to the higher side (dial rotated counterclockwise).

This makes all upper responses move from right to left across the screen. (Basis for figuring true frequency for TN-1B, TN-2B, and SPR-2 tuners).

This makes all lower responses move from left to right across the screen. (Basis for figuring true frequency for the TN-3B tuning unit).

When both an upper and a lower response of a pair from a radar signal are found, the difference in dial readings will give a key to the true radar frequency. (See charts for the different tuning units for details).

The fact that upper and lower responses can be readily identified on the panoramic adaptor scope suggests a method of searching that will save a great deal of time, especially when trying to locate an enemy signal in a frequency band that has many responses in it. An example of how to use this method is as follows:

Start the search at the lower frequency end of the band to be covered and tune up the dial. With TN-1B, TN-2B, and SPR-2 tuning units, watch for upper responses only, those which have a right to left (**<---**) movement across the pan adaptor scope. At first ignore the lower responses--the ones that move in the opposite direction.

As each upper one appears on the scope, it can be analyzed as being friendly or enemy. If a response proves to be an enemy or unknown one, the dial is already set at a suitable place for starting to determine the true frequency of the radar signal. If the wave trap does not give a check of the true frequency, it is then time to tune the dial to try to find the lower response of the pair, 60 Mc, 30 Mc, or 20 Mc below it in frequency.

Note: With the TN-3B start the search in the same way but watch for lower responses only, those that move from left to right (**--->**) across the scope, and ignore the upper ones temporarily. The lower one provides the starting point for figuring the true frequency.

--*27*--

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3. The speed with which a response moves across the scope screen when the dial is tuned at the same even rate will give a good indication as to the true frequency of a signal.

The reason for this is that the dial of each tuning unit is calibrated to be direct reading for a response of a 60 Mc pair, and when either part of such a pair is tuned in, the response can be recognized by the ordinary speed that it moves across the scope. A response that is part of a pair that is 30 Mc, 20 Mc, or less apart, will move much faster.

This fits in perfectly with the method of tuning up the dial and watching the upper responses for TN-1B, TN-2B, and SPR-2; and for lower responses from the TN-3B tuner. The speed of a response can be judged at the same time that the direction is noted.

A response of a 60 Mc pair will be one of the easiest to recognize, for there is a very apparent difference in its speed as compared to the more rapidly moving pairs, 30 Mc, 20 Mc, or less, and the very slow moving 120 Mc pairs that are occasionally seen, especially when tuning with the TN-3B unit.

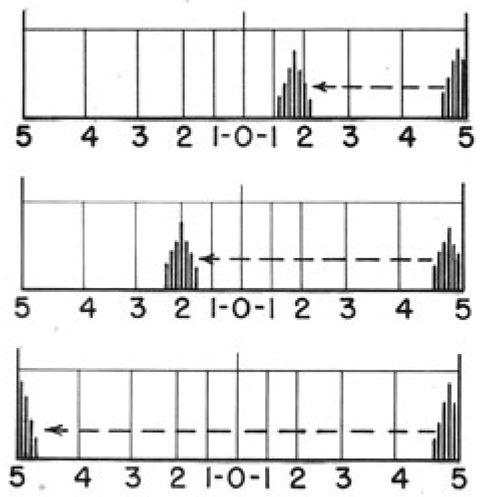
The following illustrations show the comparative speeds of three upper or higher frequency responses tuned across the scope screen when the received dial is turned counterclockwise at a steady pace.

A response that moves at any ordinary speed across the scope should be one of a 60 Mc pair. Such an upper response provides a way to read the true frequency directly from the dial for TN-1B, TN-2B, and SPR-2 tuning units.

A response that moves at twice the speed should be one of a 30 Mc pair. A wave trap should be used to make a check of the true frequency. The charts for each tuning unit can also be used to find the true frequency.

A response that moves at three times the speed should be one of a 20 Mc pair. Any of these faster responses should be checked with a wave trap, for it is difficult for the eye to tell the 30 Mc and 20 Mc ones apart.

While the illustrations show the comparison of upper responses, it would be the same for lower responses moving from left to right (--->) across the scope. With the TN-3B tuner the lower response of a 60 Mc pair can be recognized by its ordinary speed across the scope, but it should not be confused with the response of a 120 Mc pair which moves at half the speed of a 60 Mc response.

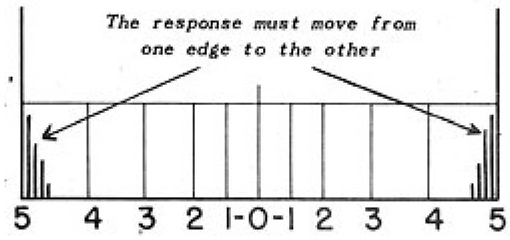


4. There is another means of determining the true frequency of any response by finding the difference in receiver dial readings as a response is tuned from one edge of the pan adaptor scope to the other edge.

--28--

The method is ito record the reading of the receiver tuning dial when the response first appears at the extreme edge of the scope screen, and to check the reading again when the response disappears off the other edge of the scope.

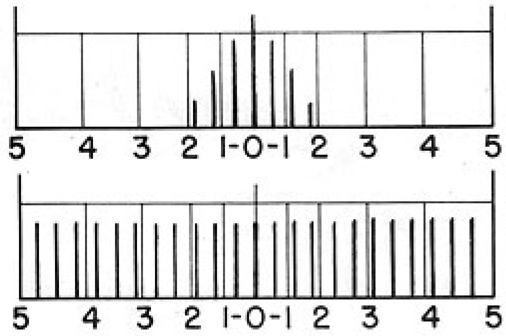
If the difference between the two dial readings is 10 Mc for moving a response completely across the 10 Mc scope screen, the true radar frequency can be read directly from the receiver dial. Likewise a difference of 5 Mc indicates a 30 Mc pair, and a difference of 3.3 Mc indicates a 20 Mc pair.



This method largely depends upon the dial divisions of the receiver being marked in 10 Mc divisions or less. Also on the pan adaptor, the signal must show plainly on both edges of the scope screen as it is moved across the scope, and the SWEEP knob must be turned all the was clockwise to give full 10 Mc presentation.

5. The pan adaptor scope provides a means of getting pulse repetition rate (PRR) information. While a good estimate of the PRR of any response can be made by observing the spacing of the rails on the scope screen, there is a more elaborate method of using the pan adaptor to get such information.

When a response has been tuned in to maximum on the receiver, it will appear in the center of the pan adaptor scope. When the SWEEP control is turned all the way counterclockwise, the rails will spread across the entire scope.



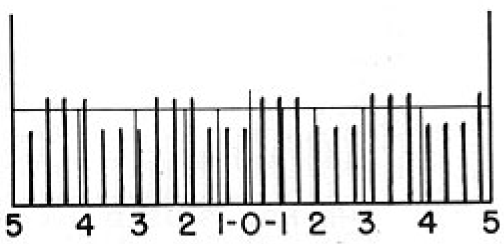
Generally these will move slowly making it difficult to count the number of rails on the screen; however, count them as accurately as possible. The number of rails multiplies by 30 will give the pulse repetition rate.

This method may be helpful when a pulse analyzer is not in use, but it is subject to error in counting the rails, and also at times the scope will show twice as many rails as should be counted (every other rail will be slightly weaker on the scope).

6. Lobe switching information can be obtained by observing a response on the pan adaptor scope when the SWEEP control is all the way counterclockwise.

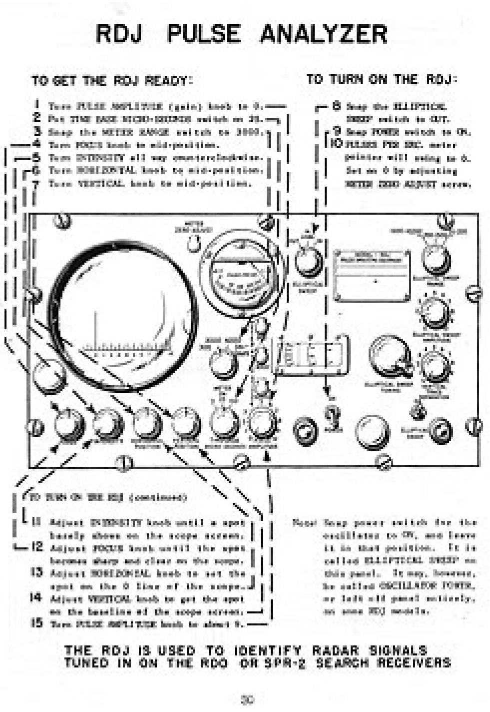
When a radar is using lobe switching, the picture on the scope will be one with groups of rails that look like blocks arranged alternately.

The closer a lobe-switching radar gets its antenna beamed on your ship, the nearer the groups of rails will become equal in height. When they level off, it indicates the radar is on target.



--29--

RDJ PULSE ANALYZER



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EXPLANATION OF STEPS AND CONTROLS USED IN OPERATING THE RDJ

1. & 15 The PULSE AMPLITUDE knob (marked GAIN on some pulse analyzers)can be turned clockwise to about .9 and left in that position. It is best to leave this gain control well advanced, and to adjust the receiver gain so that the pulse height is about 1½" high on the scope. On RDO adjust R.F.GAIN control. On SPR-2 adjust I.F.GAIN.

2. For normal operation leave the TIME BASE MICRO-SECONDS switch at METER ON - 25. In this position the pulse repetition rate (PRR) will indicate on the meter, and the scope screen will accommodate pulses up to 25 micro-seconds. Turn to 5 to get the maximum width on the screen for observing and measuring pulses under 5 micro-seconds. Turn to 100 for long pulses (over 25 micro-seconds).

3. The pulse repetition rate as read from the meter depends on the METER RANGE switch position. When turned to 300, meter reads directly; when on 3000 (usual position) meter reading must be multiplied by 10; and when on 6000, multiply reading by 20.

   The position marked CALIBRATE on the METER RANGE switch is used to get the width of any pulse in terms of micro-seconds after it has first been measured in terms of baseline markings. The method of doing this is as follows: While still receiving a signal, snap METER RANGE switch to CALIBRATE, and a series of waves will appear, each one being 1, 5, or 20 micro-seconds depending on the TIME BASE MICRO-SECONDS switch being on 5, 25, or 100. To calibrate, move the top of the first wave to the 0 line (turn HORIZONTAL knob), and then note where the top of each succeeding wave is in respect to the baseline.

4. & 12 The FOCUS knob can be adjusted and left in the same position for normal operation; however, some adjustment may help make the trace sharper when changing from the usual method of using the scope to using the elliptical sweep method.

5. & 11 The INTENSITY knob must be adjusted to keep the spot or trace as low as possible while still getting good visibility on the scope screen. never turn the INTENSITY up so high that the small spot appears brighter than the baseline or it may injure the scope. Another reason for not turning the INTENSITY too high is that it overloads the circuit and sometimes shifts the pointer on the PULSES PER SEC meter.

6. & 13 The HORIZONTAL knob moves the spot or trace on the scope screen to right or to left. It will be found necessary to use this control for positioning a pulse on the scope for accurate measurement, and for centering the trace whenever the ELLIPTICAL SWEEP switch is thrown to IN to use that method of measuring a radar pulse rate.

7. & 14 The VERTICAL knob raises and lowers the spot or trace on the scope screen. It is generally left in one position, except when used to measure the half-way point on a radar pulse.

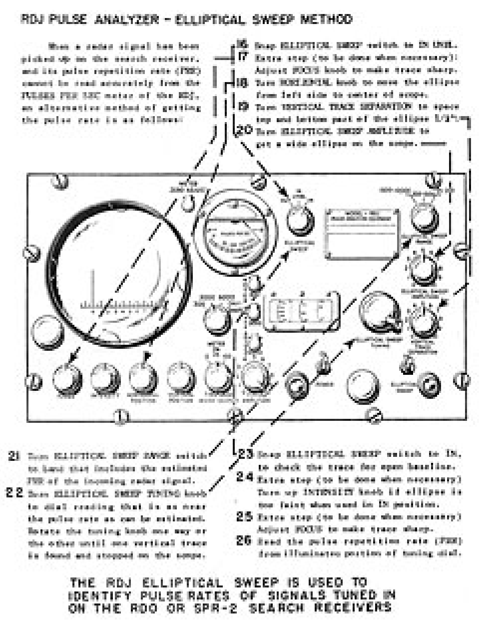
8. The ELLIPTICAL SWEEP switch in the OUT position makes the RDJ a conventional pulse analyzer like the older models, SPA-1 and APA-6A. When thrown to either of the IN positions, it throws upon the scope an ellipse pattern for measuring pulse rate.

9. The POWER switch turns the RDJ on and off. While traces or signals may appear in about 20 seconds when the RDJ is turned on, it is best to let the unit warm up about 10 minutes before regular operation. On some models of the RDJ, a separate power switch, located in the lower right corner of the panel, is provided to turn the ellipse part of the unit off while the rest of it is on. If there is such a switch, it is good operating practice to snap it ON and leave it on at all times.

10. Under ideal conditions, the pulse repetition rate of a radar signal can be read directly from the PULSES PER SEC meter as soon as a response is tuned in on the receiver. Check zero(0) reading of meter after 10 minute war-up time by turning PULSE AMPLITUDE knob to 0 (step 1). Turn METER ZERO ADJUST beside if necessary.

--31--

RDJ PULSE ANALYZER - ELLIPTICAL SWEEP METHOD



--32--

EXPLANATIONS OF STEPS AND CONTROLS USED IN SETTING UP THE RDJ

16. & 23 The ELLIPTICAL SWEEP switch, when on IN UNBL or IN positions, makes it possible to use the unit to measure accurately the pulse repetition rate of a radar signal by putting an ellipse pattern on the scope, and then tuning an audio oscillator until the oscillator's frequency matches that of the incoming radar signal, at which point the PRR can be read from the dial markings. IN UNBL position is generally preferred for preliminary work because it gives a brighter picture on the scope screen, but IN shows up an opening in the baseline better.

17. & 25 The FOCUS knob ordinarily can be set and left on one position; however, with some scope tubes, it may have to be adjusted when ELLIPTICAL SWEEP switch is changed.

18. The HORIZONTAL knob needs to be adjusted when the unit is switched from one function to the other. Note the setting that was used for pulse presentation on the scope, before switching over and centering the ellipse, so that no time will be lost returning to the other position.

19. VERTICAL TRACE SEPARATION does exactly what the name implies as it separates the upper and lower part of the ellipse. About one-half inch spacing is the usual amount. This control can usually be set to about 5 and left alone.

20. ELLIPTICAL SWEEP AMPLITUDE widens the ellipse on the screen and makes it easer to observe the moving spots or vertical traces when turning the audio oscillator.

21. The ELLIPTICAL SWEEP RANGE switch has three ranges of frequencies: 25 to 200 cycles, 200 to 1500 cycles, and 1500 to 10,000 cycles. For rapid operation a close guess as to which of these to use is needed. The guess may be based on the sound of the radar signal in the

headphones. It may be a rough guess from any reading that can be obtained from the PULSES PER SECOND meter. The guess may also be based on information of the known frequency of a radar that it might be. It is not good operating to start on one end and tune over the entire ranges, for it is a long process and quite confusing because of the number of patterns that can be seen on the scope.

22. The ELLIPTICAL SWEEP TUNING knob is the control that has the job of pinning down the pulse repetition rate of the incoming radar signal. As the control is rotated, different patterns will appear on the scope. The search is for a single spot or rail with an open baseline beneath it. When it is found, the pulse repetition rate cn be read directly from the illuminated portion of the tuning dial.

    It is also possible to determine PRR when more than one trace is see on the scope. When two traces are found, and checked for open baseline, read dial and multiply by 2 to get the PRR. When three traces are found, and checked for open baseline, read the dial and multiply × 3 to get the PRR. The difficulty of checking for open baseline is increased as the number of traces increase on the scope, however.

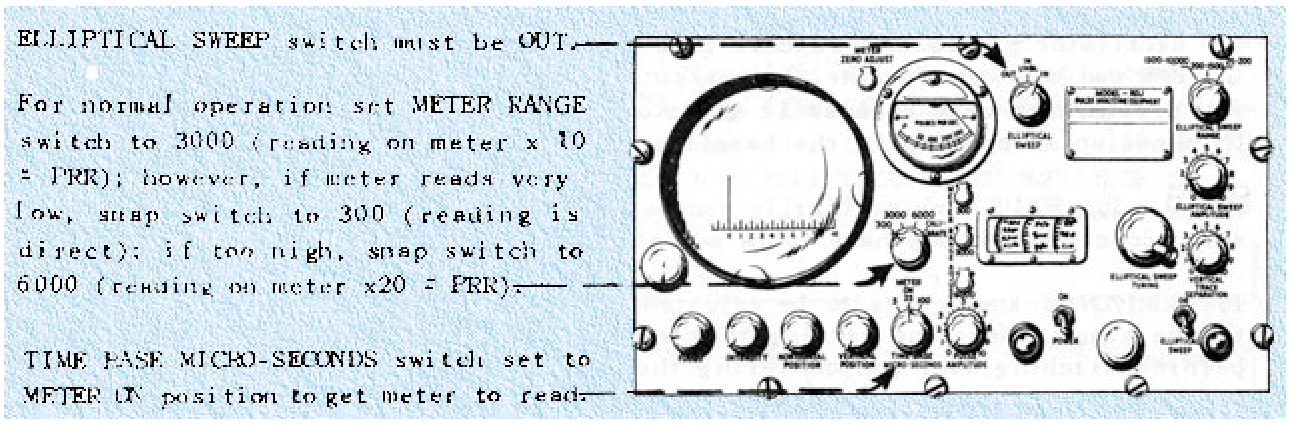
24. Some times when the ELLIPTICAL SWEEP switch is snapped to IN, it is necessary to turn the INTENSITY control up tp present a brighter trace on the scope.

26. The tuning dial set behind the panel has three ranges corresponding to the positions of the ELLIPTICAL SWEEP RANGE switch. The one in actual use is always indicated by the light on the scale, and only that scale should be read.

--33--

INFORMATION THAT CAN BE OBTAINED FROM THE PULSE ANALYZER

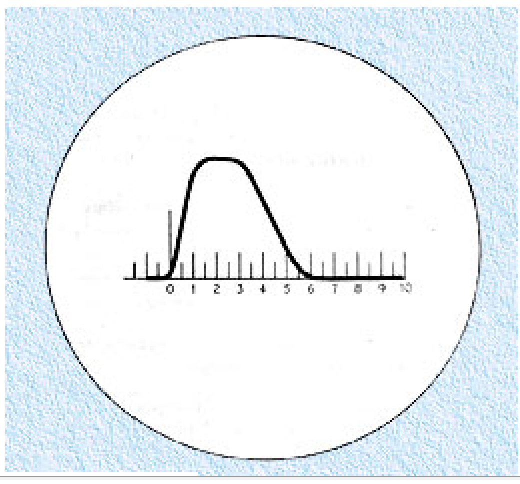
1. The PULSE REPETITION RATE (PRR), also called pulse repetition frequency (PRF), is important information for identifying any radar signal. Under ideal conditions this can be read from the PULSES PER SEC. meter as soon as a response is tuned in.



When there is interference, the usual method to follow is to leave the PULSE AMPLITUDE (gain) control at 9, and depend on adjusting the receiver gain, and also the receiver tuning, to try to get a correct reading on the meter.

At times it may be difficult lor impossible to get an accurate reading from the meter, especially when several signals on the same frequency combine to read the total pulse rate. It is then that the elliptical sweep method will help get the PRR.

2. The PULSE SHAPE as it appears on the scope screen may have characteristics that identify it as enemy or friendly, or as something new. Differences in pulse shapes will provide a means of separating signals that are on the same frequency. It also will show variations within a single signal, as lobe-switching.



Accurate presentation of pulse shape starts with getting the response tuned in carefully on the receiver.

The TIME BASE MICRO-SECONDS switch is normally at 25, but use 5 if it is possible to get a wider pulse that will still fit on the scope screen.

Some adjustment of the PULSE AMPLITUDE (gain) control, or of the receiver gain control, will be necessary to get the pulse as high as possible without the top of it becoming distorted.

When properly presented on the scope, the pulse shape can be compared with other known pulses; it can be sketched and logged; its width can be measured.

--34--

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3. The PULSE WIDTH (PW), also known as pulse length (PL), is a measurement of the radar pulse in terms of micro-seconds. Carefully obtained from a properly adjusted pulse shape, it is a good means of identification. Incorrectly obtained, it can be very misleading information. The following method of measuring is recommended.

    First, get an accurate pulse shape on the scope.

    1. Tune signal in carefully by listening to the phones and by watching the pan adaptor scope.
    2. Get pulse as wide as possible and still fit on screen (Set TIME BASE MICRO-SECONDS switch).
    3. Adjust the pulse to best height for measuring, but do not let the top of it become distorted.

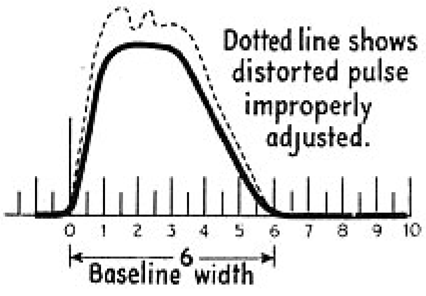
    More careful measurement can be made by moving the pulse to right or left by turning the HORIZONTAL knob on the pulse analyzer. Illustration 1 shows the position for baseline measurement. No. 2 shows the method of cutting the left-hand slope in half by the "0" line. No. 3 shows the method of using the VERTICAL knob to lower the half-way point to the baseline as an additional aid to measurement.

    Measure each pulse at half-way point and at base.

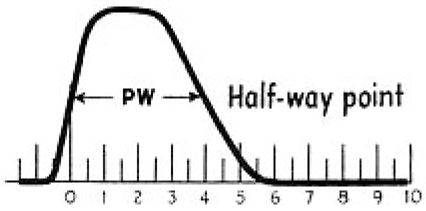
    1. The width of pulse at half-way point from baseline to top of pulse will give the pulse width.
    2. The width at baseline will provide information for indicating the general shape of the pulse.

    Both of these measurements will first be read from the scope in terms of the 0 to 10 baseline markings.

An approximate method of changing baseline measurements into micro-seconds is to make a scale for each pulse analyzer for the two positions used most often (TIME BASE MICRO-SECONDS switch at 5 and 25). Such a scale made from one pulse analyzer is shown. This method is quicker and easier than calibrating each signal individually, but is not considered accurate enough for reporting enemy radar signals, for the width of the pulse on the screen and the width of the calibration markers become narrower as the pulse repetition rate increases. There may be an error as much as 25% in such a scale.

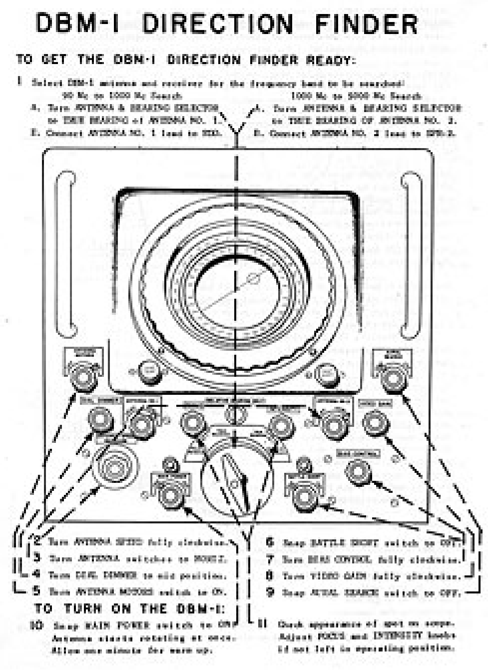


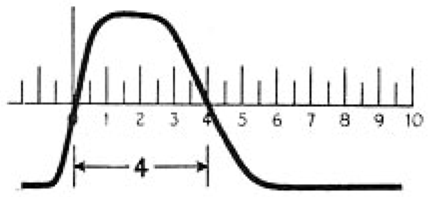
Accurate measurement of the pulse width in micro-seconds requires that the METER RANGE switch be turned to CALIBRATE while the signal is still tuned in. An easy method is to move the top of the first marker wave to the "0" line, and then mark the points on the baseline that correspond to the tops of the following waves. With this calibration, the baseline readings can be converted to micro-seconds.

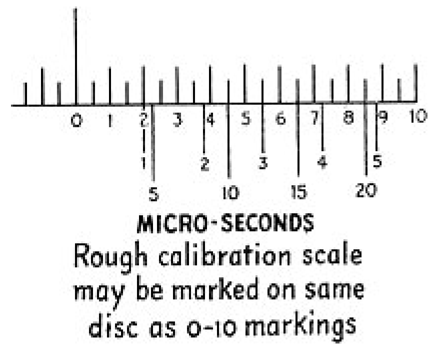


--35--

DBM-1 DIRECTION FINDER







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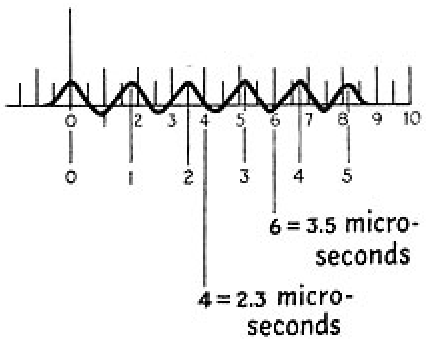


EXPLANATION OF STEPS & CONTROLS USED IN OPERATING THE DBM-1

1.
   A. Turning the ANTENNA & BEARING SELECTOR switch (not labeled on panel) to the TRUE BEARING position of either antenna does the following:

      1. Connects either ANTENNA NO. 1 or ANTENNA NO. 2 to the DBM-1 indicator unit and starts the antenna rotating so that directional patterns can be seen on the DBM-1 scope when the system is in complete operation.
      2. Connects the RDO receiver to the indicator unit when in ANTENNA NO. 1 position, or the SPR-2 receiver to the unit in ANTENNA NO. 2 position.
      3. Provides true bearing reading for the DBM-1 scope by means of a gyro-controlled (outer) disc around the scope. RELATIVE BEARING positions on the switch are used only when the ship's gyro fails, to make the true bearing disc read the same as the relative bearing (inside) disc.

   B. Ordinarily a change in the ANTENNA SWITCH position, or a change in the ANTENNA JACK BOX connections, or sometimes both, is all that is needed to connect the proper antennas to the receiver. A check should be made to make sure that any wave traps in the antenna lead are switched to OUT while searching.

2. ANTENNA SPEED control should be left on full for ordinary operation as it provides the best chance of intercepting radar signals throughout 360°, especially sweeping radar signals. The antennas are designed for continuous rotation.
3. ANTENNA NO. 1 and ANTENNA NO. 2 switches provide means of changing between the VERT (vertical) and HORIZ (horizontal) antennas located in each of the two antenna mounts. For preliminary search work it is best to snap switch to HORIZ, for in that position the search system gets the greatest pick up from horizontally-polarized radar signals (the most common type) and can still get pick up from signals of different polarizations.
4. DIAL DIMMER controls the amount of light on the bearing markings around the outer edge of the scope. keep the light turned down while searching. Too much light causes reflections on the face of the scope that make it difficult to observe weak signals. Turn light up whenever necessary to read bearings of any signal received.
5. ANTENNA MOTORS switch must be ON to provide rotation for 360° intercept. If let OFF, the antenna will not rotate and will receive in one direction only. Whenever the DBM-1 antenna is not needed for any length of time, it is advisable to turn the ANTENNA MOTORS switch OFF to reduce the wear caused by continuous rotation.
6. BATTLE SHORT switch should be left OFF except in combat emergencies when a quick check is needed to try to get the DBM-1 unit working should it suddenly quit.
7. BIAS CONTROL is a secondary gain control, which is turned counterclockwise to try to eliminate a weaker signal when several signals are seen on the DBM-1 scope.
8. VIDEO GAIN is usually left in full position, and receiver gain (R.F. GAIN on RDO; I.F. GAIN on SPR-2) used instead to get the best presentation on the DBM-1 scope. Some reduction of VIDEO GAIN is better than turning the receiver gain too low.

9. AURAL SEARCH is left in OFF position. While it can provide a way of rotating the other DBM-1 antenna (the one not connected to the scope) so that it can be used with the other receiver, no provision is made in the standard type installation to do it.

10. MAIN POWER switch is usually turned on when the search receivers are turned on.

11. Method of adjusting scope. With receiver gain turned down, proceed as follows:

    1. Turn INTENSITY knob to make spot on scope easy to see but not too bright.

    2. Turn FOCUS knob to make the spot as sharp and as clear as possible.

    3. Adjust CENT VERT set screw if spot is above or below center crossline.

    4. Adjust CENT HORIZ set screw if spot is to left or to right of center crossline.

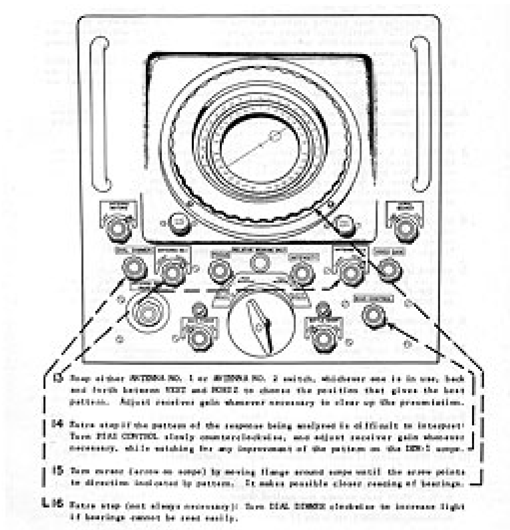
--37--

TO OPERATE THE DBM-1:

12. Adjust receiver gain (R.F. GAIN on RDO. I.F. GAIN on SPR-2) as follows:

    A. Extra step if search for radar signals is to be done by watching DBM-1 scope: adjust receiver gain to get about u1/2" of grass in the center of the scope.

    B. When a response has been tuned in on the receiver, adjust receiver gain to get the best presentation on the DBM-1 scope, and then proceed to step 13.



--38--

EXPLANATIONS OF STEPS AND CONTROLS USED WITH THE DBM-1:

12. The receiver gain (R.F. GAIN on RDO, I.F. GAIN on SPR-2) should be used in preference to the DBM-1 VIDEO GAIN control. After a response has been tuned in on the search receiver, making the gain adjustments with the receiver gain, and leaving the VIDEO GAIN on full, consistently gives better patterns on the DBM-1 scope. In certain systems VIDEO GAIN may have to be reduced to some extent, particularly with the SPR-2, in order to obtain normal grass on the DBM-1 scope and still have the receiver gain advanced enough to be able to pick up weak radar signals.

    A different amount of gain is generally required for best operation of each of the units of the search system. An adjustment of gain is necessary when sifting attention from listening in the phones to observing one of the scopes of the other units, such as the direction finder. Rather than to try to use a large number of gain controls on the different units, it is good operating practice to pre-set and leave most of them in one position, and use the receiver gain.

    The usual method of searching has the receiver gain set for comfortable headphone volume. This setting may cause a blur of light to appear on the DBM-1 scope, but it will do no harm, and can be made to disappear instantly by adjusting the gain for best pattern on the direction-finder scope. The blur on the scope may be eliminated temporarily when no attention is being paid to the DBM-1 by turning the BIAS CONTROL counterclockwise; however, the latter should be turned fully clockwise before starting to make adjustments for a pattern to be analyzed.

13. The ANTENNA NO. 1 or ANTENNA NO. 2 switch not only helps to get the best pattern on the scope, but its final position indicates whether the signal is horizontally polarized (HORIZ) or vertically polarized (VERT). Should there be little choice between the two positions, it may indicate that the signal has some combination of the two polarizations.

    The switch also has uses in searching. If the search is for an enemy radar known to be using vertical polarization, turn the switch to VERT position before beginning the search. Likewise, when on unidentified signals can be heard when the normal HORIZ searching position is used, turn the switch to VERT position and tune over the band for responses. The switch should be in the normal HORIZ position for all ordinary search over the dial.

14. The BIAS CONTROL can be used to eliminate a minor lobe, a weaker signal, or weaker interference, that may be making it difficult to interpret the pattern of the desired signal. Its effect is to eliminate the weaker pattern completely from the scope, thus making the stronger pattern stand out free and clear. After using this control on one response, turn it fully clockwise before continuing the search for other responses.

15. The CURSOR provides convenient way of reading bearings more accurately, When left on the pattern after taking a reading, it also provides a reference point for noting any change in the direction of the radar.

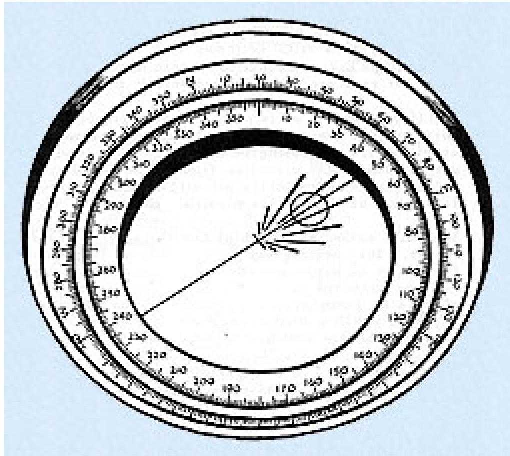
16. The dial dimmer can be left in mid position if it is possible to read bearings without extra light. Even the use of a hood over the scope to aid in seeing the weaker patterns does not eliminate the objectionable reflections that can be caused by too much light. If the DIAL DIMMER must be turned up to read bearings, be sure to turn it back to mid position before continuing the search.

Note: When the direction finder is to be shifted from one frequency band to the other, the change will require the preliminary settings outlined in step 1, and steps 12 to 16. Once properly set, the majority of the DBM-1 controls do not have to be touched during operation.

--39--

INFORMATION THAT CAN BE OBTAINED FROM THE DIRECTION FINDER

1. The main purpose of the DBM-1 direction finder is to give true and relative bearing readings of any radar signal tuned in on the search receiver.

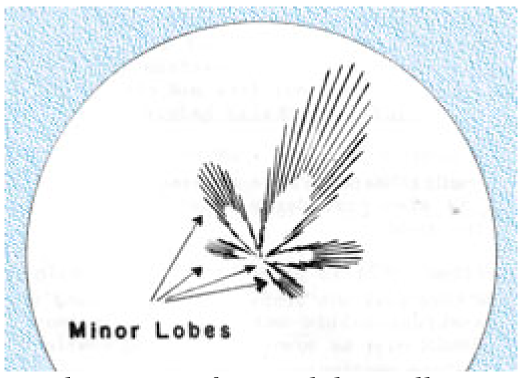


This the DBM-1 does byb means of a rapidly rotating diurectional antenna that picks up the radar signal each time that it points at the radar.

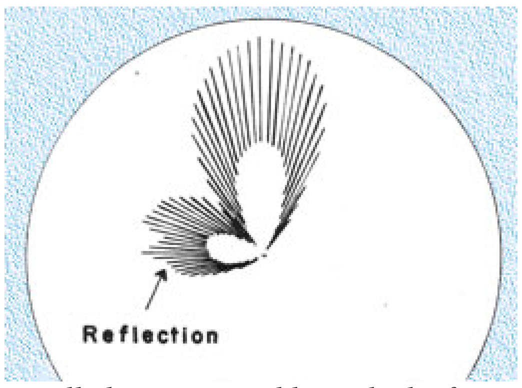
When the search receiver is tuned to one of the responses of the signal, it is heard as a "zip, zip, zip" in the pohones, and is seen as flashes that make a pattern on the DBM-1 scope.

The ideal pattern for measurement is a single symmetrical lobe, like the illustration, for the cursor line can be set to bisect it, and the true bearing can be read from the gyro-controlled outer disc, and the relative bearing from the inner disc.

The same method of bisecting the major lobe is used to get bearings from patterns that are complicated by the appearance of minor lobes and reflections. Minor lobes are due to antenna design, and consequently are much more of a problem with the DBM-1 low frequency antenna, especially below 300 Mc. Reflections are due to the radar signal striking an object, such as a part of the ship, and reflecting into the antenna, usually at a different angle.



The number, size, and position of minor lobes will vary according to the antenna used and the frequency, but will show a symmetry in respect to the major lobe.



A reflection can usually be recognized by its lack of symmetry in the whole pattern, sometimes by its irregular shape and its small size than a major lobe.

--40--

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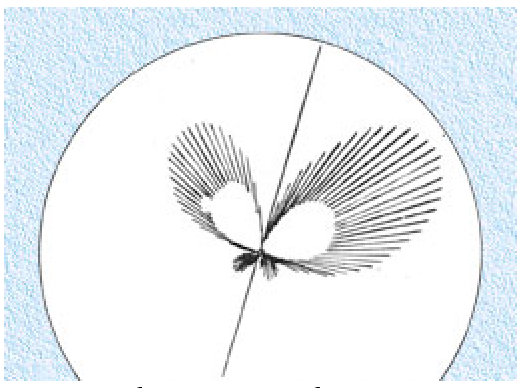
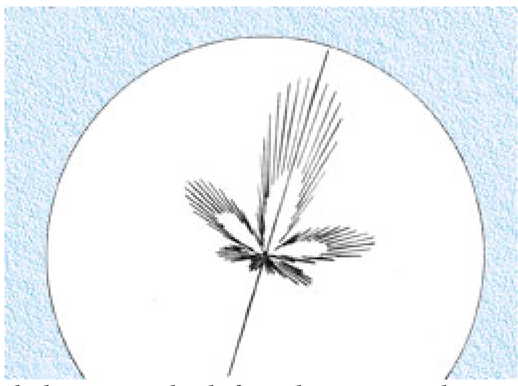
2. By changing between the horizontal and vertical antennas in each DBM-1 antenna mount (ANTENNA VERT--HORIZ switch), it is generally possible to determine whether a radar signal has horizontal, vertical, or some other type of polarization. Polarization information is obtained by noting the switch position that gives the most readable pattern on each radar signal.



The lack of symmetry in the pattern with no apparent major lobe in it, usually indicates the wrong choice of antenna polarization. The other antenna polarization should be tried.



The same signal shown on the left with wrong polarization has a pattern that is symmetrical with a major lobe, when the correct choice of antenna polarization is made.

True bearing and polarization information are obtained at the same time, and the problems involved are much the same. There are no easy rules that apply to all of the patterns that appear on the DBM-1 scope, but there are a number of things that the operator can keep in mind to help him understand what he sees:

1. Patterns will vary greatly in shape and readability according to the frequency band being searched. The main reason for this is the difference in the efficiency of the antennas. Below 300 Mc the patterns may be difficult to interpret, for the major lobe will be broad, and the minor lobe is quite easily confused with the major lobe. From 300 Mc to 1000 Mc the patterns will show noticeable improvement as the frequency is increased. From 1000 Mc to 5000 Mc the patterns in general will be the best in symmetry and readability, because of the much better efficiency of the DBM-1 high frequency antenna.

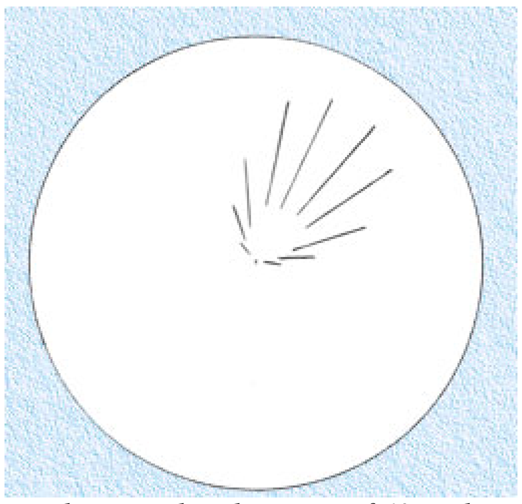
2. A number of the patterns that are difficult to analyze are responses from nearby radars. A local radar not only puts a strong signal into the search intercept system, but it may cause reflections that complicate the pattern seen on the DBM-1 scope. There is a wide difference in the performance of the direction finder in comparing the doubtful results obtained in a crowded harbor with the patterns of distant radars picked up when at sea.

3. The pattern obtained from a radar signal may show flashes on the scope screen that are different in size and shape. The usual cause of the change is the variations that result from the DBM-1 rotating antenna picking up a signal from a radar antenna that is rotating at a different speed.

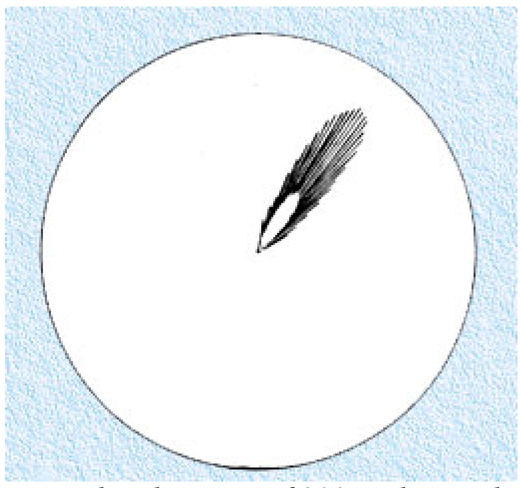
4. Poor patterns may be caused by equipment troubles, such as the relays operated by the *Antenna Vert-Horiz* switches not making good contact, antenna rotary joint in need of cleaning, etc., in which case consult the technician.

--41--

3. An estimate of the pulse repetition rate (PRR) can be made by observing the spacing between the lines of the pattern as shown on the DBM-1 scope. Such an estimate is especially useful in obtaining a rough idea of the PRR of a signal that is sweeping so rapidly that the pulse analyzer cannot be used. It is also valuable in picking out a desired signal from several patterns that appear on the scope at the same time.



The pattern of a radar signal with a PRR of 60 cycles, commonly used by air search radars, is readily identified by the wider spacing between the lines of the pattern.



The pattern of a signal with a PRR of 800 cycles, such as a surface search radar might use, presents a picture with noticeably narrower spacing between the lines.

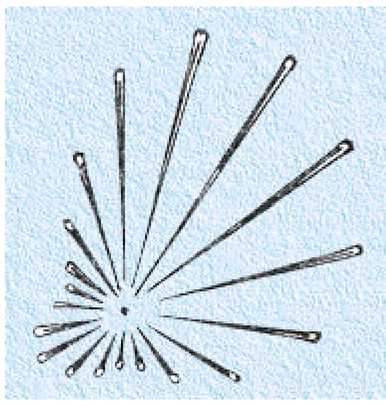
The ability to make close estimates of pulse repetition rates from the pattern on the DBM-1 scope is something that is acquired by practice and experience. The operator who wishes to acquire this skill should take a wide variety of signals with different pulse rates, measure each with the pulse analyzer, and then try to connect each PRR with its pattern on the DBM-1 scope. In a reverse manner, make an estimate of a signal with an unknown PRR, and then check it with the pulse analyzer.

All estimates should be made with the *Antenna Speed* control turned fully clockwise to provide a reliable bases on which to judge the spacing between the pulse lines. If the antenna rotation speed is decreased, the spacing between the pulses will increase, and thus give the appearance of a slower pulse repetition rate.

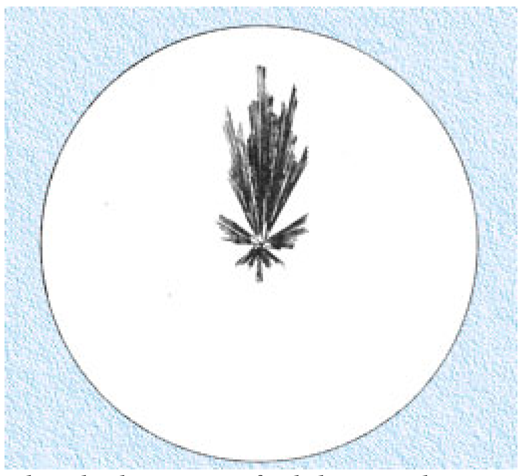
4. A very rough estimate of pulse width (PW) may be made by observing the appearance of the tips of the pulse lines on the direction finder scope.

   For all practical purposes it is sufficient to know that when the tip of a line becomes noticeably brighter than the rest of the line it indicates that the pulse width is probably over 5 micro-seconds.

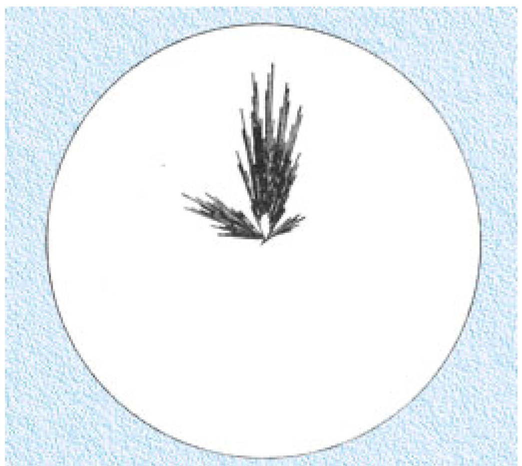
   The value of such a rough estimates is necessarily limited, but may be of some use when no pulse analyzer is in operation.



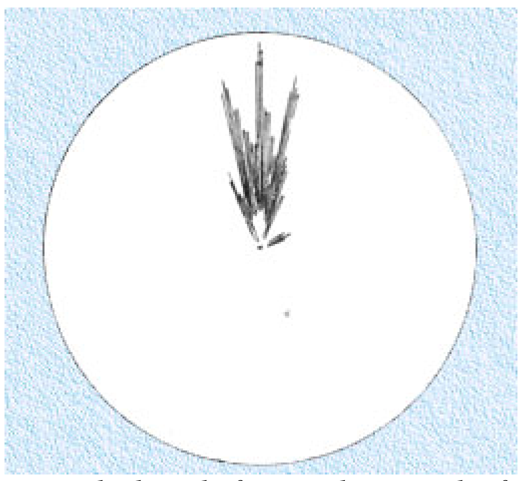
5. It is possible to tell whether or not a radar whose pattern is seen on the DBM-1 scope is using lobe switching. The method of identification is to note differences in the length of the lines in the pulses seen in the major lobe. The chief value olf observing lobe switching on the DBM-1 is for quick recognition. It is better to depend on the pulse analyzer and pan adaptor scopes for detailed information.



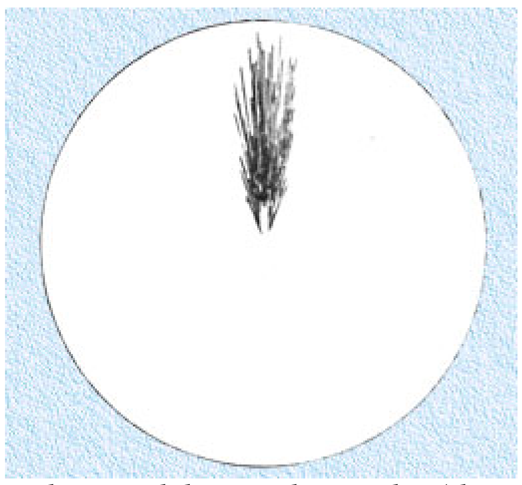
This represents the ideal pattern of a lobe switching radar on the DBM-1. It can be identified by the groups of pulses of different lengths in a symmetrical lobe.



A typical picture of a pattern of a lobe switching radar on a DBM-1 shows that the pulses are of different lengths but do not appear to be arranged in groups.



This drawing was made directly from a photograph of a response from a lobe-switching radar with a PRR of 1640 cycles at a time when the radar was searching.



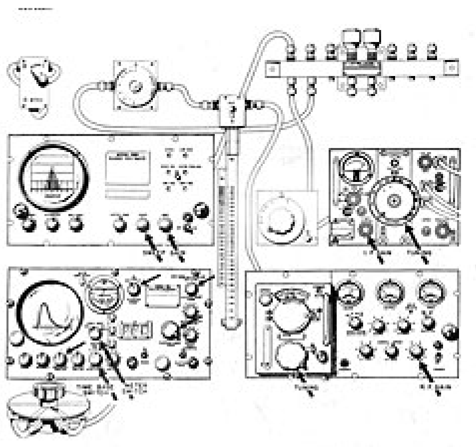
The pattern from the same lobe-switching radar (shown at left) has pulse lines that are more even in length when the radar is beamed directly at the ship.

RADAR INTERCEPT SYSTEM

Controls Needed for Search Intercept Operation

The following illustration shows the system set up for searching from 1000 Mc up with the SPR-2 receiver. Details as to getting the system ready for searching below 1000 Mc with the RDO receiver are given on the opposite page.

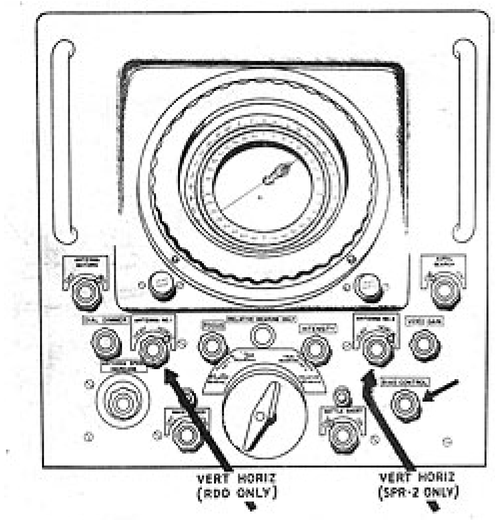
The arrows are to emphasize the fact that once the controls are set in position properly at the beginning of a search watch, radar intercept can be done by using only two controls on either the SPR-2 or the RDO; one (sometimes two) on the RDP; two on the RDJ, except when elliptical sweep method is used to determine PRR, when four more are needed; one (possibly two) on the DBM-1; plus wave traps and antenna switch.



--44--

A BRIEF SUMMARY OF THE STEPS AND CONTROLS USED IN MAKING AN INTERCEPT OF A RADAR SIGNAL.

1. The antenna switch must be turned to one of the antennas for the frequency band to be searched, and the cable connected through the antenna jack box to either the SPR-2 or the RDO. The wave traps should be left in out position while searching.
2. The SPR-2--RDO switch connects the RDP and RDJ to SPR-2 or RDO, and the selector switch on the DBM-1 connects that unit to SPR-2 (Ant. No. 2) or RDO (Ant. No. 1).
3. Plug headphones into receiver to be used; and for RDO, plug in tuning un it needed.
4. The receiver gain (I.F. GAIN on SPR-2, R.F. GAIN on RDO) is adjusted to get sufficient background noise to be able to hear any radar responses that are tuned it.
5. A response that is heard in the phones should appear on the pan adaptor scope. If it is difficult to see. the scope picture may be improved by adjustment of the gain (RDP GAIN is used with RDO; same control left on full and I.F. GAIN used with SPR-2), and also by adjustment of the SWEEP control. The tone of the response in the phones and the dial reading of the receiver, together with the direction, speed, and spacing of rails of the same response on the pan adaptor scope, provide the first information about the true frequency and PRR of the radar.
6. The pulse repetition rate may sometimes be obtained from the meter on the RDJ. If the meter reads too high or low, the METER RANGE switch position may have to be changed, and the receiver gain adjusted. An estimate of the pulse width can be made, using the TIME BASE switch to get the widest pulse that will fit the scope screen.
7. If such a rapid check does not identify the response as one from a friendly radar, more exact information will be required. The wave trap (F-26 for SPR-2, F-20 and F-19 for RDO) will provide a close estimate of true frequency, which can be checked against receiver dial and tuning chart.
8. Accurate PRR can be determined by the elliptical sweep method, and close measurement of PW can also be made on the RDJ.
9. The direction of the radar will be indicated by the pattern on the DBM-1 scope. Adjustment of receiver gain, possibly some adjustment of BIAS CONTROL and switching between VERT and HORIZ on the polarization switch will be necessary to get the most readable pattern.



--45--

SPECIAL NOTE

Because certain types of ships will have radar search equipment without any jamming transmitter, the first part of the manual has been written about the intercept system only, wthout any mention of jammers.

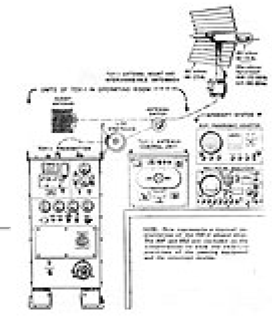
A thorough knowledge of the operation of the radar intercept system is a prerequisite to learning the operation of a jamming transmitter, such as the TDY-1.

--46--

TDY-1 RADAR JAMMING SYSTEM

The TDY-1 is the present type-allowance shipboard radar countermeasures jamming transmitter that is used with the radar intercept system.

The transmitter is designed to jam with noise modulation any radar signal between 115 Mc and 770 Mc. Its average power output of about 125 watts, together with its directional antenna, make it the most powerful jammer of its type in the fleet.



--47--

PRELIMINARY TUNE UP SIMPLIFIES TDY-1 OPERATION IN COMBAT

Both operators find the enemy signal on their search receivers. Both have had the same advance information as to the approximate frequency on which to expect the enemy, so each is prepared with the proper antenna and magnetron. Both have studied and can follow the step-by-step procedure to put the jamming transmitter on the air.

Operator No. 1 has made a special calibration chart for the magnetron he has in the set. He refers to this chart, and sets FREQUENCY and COUPLING controls to the numbers that have made the set perform best at the frequency the enemy is using.

He can expect that when the TDY-1 is turned on, the signal will appear on the pan adaptor scope, for the receiver dial and the transmitter FREQUENCY control have been checked against each other.

The problem of getting nearly maximum output into the antenna doesn't trouble him, because the COUPLING adjustment has been carefully made when there was plenty of time. He knows his transmitter has been tuned to eliminate pulsing, and also he has had the practice of taking care of pulsing should it occur under combat conditions.

Operator No. 2 has depended upon the chart that comes with the TDY-1 to set his transmitter to the frequency of the enemy radar. It tells where to set the FREQUENCY control, but that is no assurance that the TDY-1 signal will appear on the same frequency markings on the dial of the receiver. (Receiver dials have been known to be as much as 30 Mc off). He must take time to find the main signal, and check to make sure he is not on the image.

He has no figures on COUPLING for this particular magnetron, and finds that adjusting the COUPLING throws the frequency off, upsets the normal voltages and currents on the set, and sometimes causes the transmitter to break into pulsing. The figures he obtained from a similar magnetron do not help him much with the tube in the set.

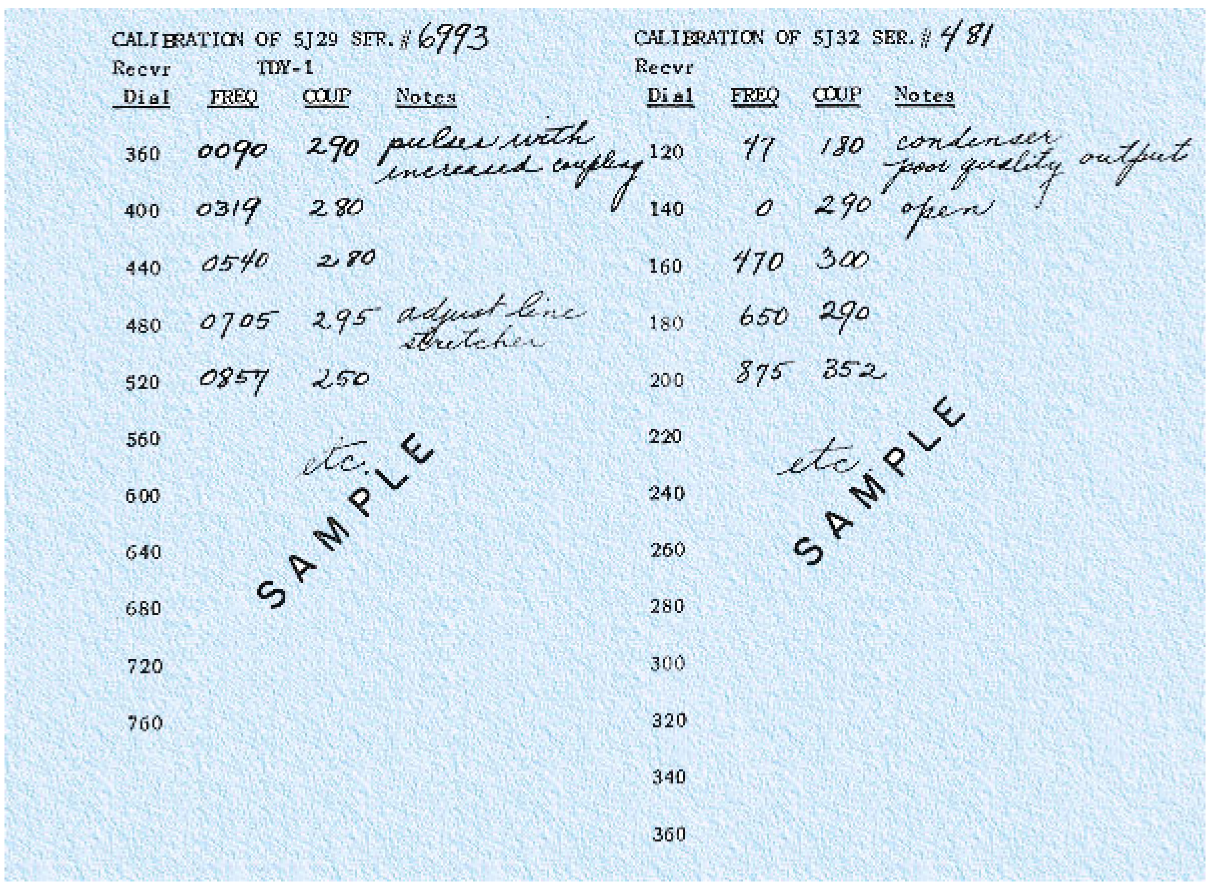
I takes a lot of time and effort to tune up each magnetron, and to make a chart or curve of the results. It is a clear-cut proposition, however, of whether the operator would prefer to tune up each tube at some suitable place when there is plenty of time to get everything right, or would prefer to do the same work under the stress of combat conditions when every second counts.

--48--

CALIBRATION OF EACH MAGNETRON IS NECESSARY FOR MOST EFFICIENT OPERATION

A suggested method of calibrating is to set the receiver tuning dial to the lowest frequency of each magnetron (360 for 5J29, 120 for 5J32), then tune up the TDY-1 and adjust FREQUENCY and COUPLING controls to get the maximum power into the antenna without pulsing. Record the settings. Move the receiver dial to the next frequency, and tune up again.

The points suggested below are the minimum number that should be obtained. At frequencies known to be in use by the enemy, some extra points, 5 Mc apart, should be recorded.



CALIBRATION OF 5J29 SER. # 6993

Recvr Dial	TDY-1 FREQ	COUP	Notes
360	0090	290	pulses with increased coupling
400	0319	280	
440	0540	270	
480	0705	295	adjust line stretcher
520	0857	250	
560			etc.
600			
640			
680			
720			
760			

CALIBRATION OF 5J32 SER. # 481

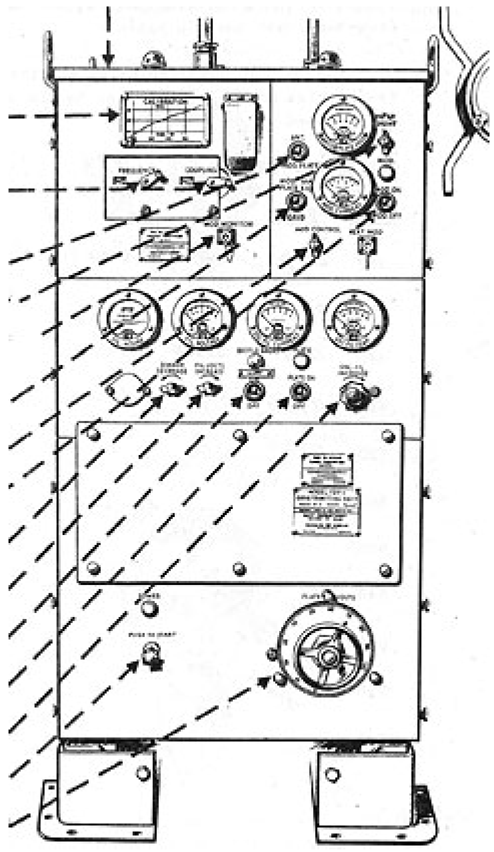
Recvr Dial	FREQ	COUP	Notes
120	47	180	condenser poor quality output
140	0	290	open
160	470	300	
180	650	290	
200	875	352	
220			etc.
240			
260			
280			
300			
320			
340			
360			

SAMPLE SAMPLE

Note: Should the operator find difficulty calibrating the extreme ends of the range of either magnetron, it is more likely to be caused by an error in the dial calibration of the receiver than by the inability of the magnetron to cover its full range.

--49--

TO GET THE TDY-1 READY TO TURN ON:



1. Connect the transmitter to dummy antenna for tuning up. The lead must be connected to either dummy or regular antenna during operation to prevent damage to equipment.
2. Turn line stretcher control to about the middle (about 65 turns from either end).
3. Check that set has proper magnetron, and attachments if needed, for desired frequency.
4. Select tuning numbers from calibration chart to correspond with receiver dial setting where the enemy radar is being picked up or is expected to be heard.
5. Loosen LOCK knobs, and turn FREQUENCY and COUPLING controls to chart numbers. Set COUPLING at 0150 if not calibrated.
6. Snap switch down to MOD PLATE position.
7. Turn METER SHUNT knob to about half-way.*
8. Connect oscilloscope to MOD MONITOR jack.**
9. Snap the MOD MA switch up to PLATE X 10.
10. Turn MOD CONTROL knob to about half-way.
11. Snap MOD ON switch to the up position.
12. Turn DIMMER knob all the way clockwise.
13. Turn FIL VOLTS knob to about half-way.
14. Snap the BATTLE SHORT switch down--OFF.
15. Snap PLATE switch to down position--OFF.
16. Turn OSC FIL all way counterclockwise.
17. PUSH TO START switch is pulled out--OFF.
18. Turn PLATE VOLTS handwheel to 0.

Note: * If METER SHUNT control (step 7) is on a separate box, it should be mounted on panel in position indicated in accordance with BuShips TDY Field Change No. 5.

** The oscilloscope (step 8) is not provided as part of the TDY-1 equipment, because the transmitter can be operated without it. The value of using such a scope, however, is in tuning up the set to get the best modulation without pulsing. The oscilloscope controls can be set ahead of time in the usual way, so that after turning the scope on, only the sweep control need be adjusted (usually between 30 and 60 cycles) to provide a good way of detecting pulsing in the TDY-1.

EXPLANATION OF STEPS AND CONTROLS USED TO GET TDY-1 READY

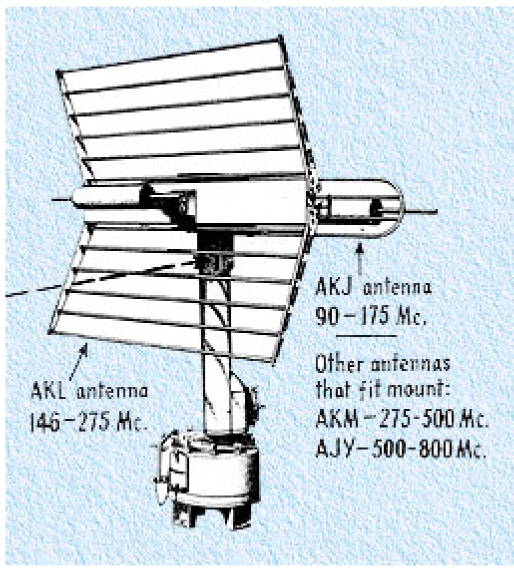
1. Connecting the transmitter (through the line stretcher) to the dummy antenna has two advantages: (1) tuning up may be done without giving any advance warning to the enemy, and (2) work may be done on the regular antenna at the same time the set is tuned up.
2. Setting the line stretcher, which has about 130 turns in all, to about mid position will help to prevent running into either end while using it during operation.
3.

Tube	Attachment	Total Range	Best Use	Tube	Total Range
SJ32	capacitor	115 to 150 Mc	115 to 140 Mc	5J29	360 to 770 Mc
"	none	140 to 300 Mc	140 to 300 Mc		(no attachments)
"	long short	280 to 390 Mc	300 to 360 Mc		
"	short short	310 to 410 Mc	--------------		

4. The best type of calibration chart is one made for each magnetron by the ship (see pages 2 & 3). A calibration of FREQUENCY only is supplied with the equipment.
5. The FREQUENCY control is used as often as needed to put the TDY-1 on frequency. The COUPLING control is used to get maximum transfer of power to the antenna. Do not force either control. Never set COUPLING to 0000 as it makes the FREQUENCY control hard to turn. The FREQUENCY control cannot turn to 0000 unless COUPLING is over 0250, and it cannot turn to the other end at 1650 unless COUPLING is under 0185.
6. ANT--MOD PLATE switch connects ANT OR PLATE VOLTAGE meter to read either transmitter plate voltage or transmitter r-f output obtained from a pickup unit near the antenna.
7. METER SHUNT knob keeps ANT OR PLATE VOLTAGE meter reading about mid scale for ANT use.
8. An oscilloscope provides a method of observing modulation and detecting pulsing.
9. MOD MA switch changes MOD CURRENT meter to read either grid or plate currents.
10. MOD CONTROL knob regulates the amount of noise modulation on the TDY-1 signal.
11. MOD ON switch is left in up position for normal operation.

12. DIMMER knob is usually set on full to show when lights, POWER, MOD, PLATE, go on.
13. FIL VOLTS knob provides a small adjustment of filament voltage on all tubes except the magnetron.
14. BATTLE SHORT switch is left in OFF position to provide protection against accidents due to contact with high voltage points. Snap to ON only in combat emergencies.
15. PLATE switch is used in conjunction with PLATE VOLTS control to apply plate voltage.
16. OSC FIL knob controls the filament current of the magnetron.
17. PUSH TO START switch applies or removes the main power to the TDY-1 transmitter unit.
18. PLATE VOLTS control adjusts high voltage as shown on ANT OR PLATE VOLTAGE meter.

TO GET ANTENNA SYSTEM READY



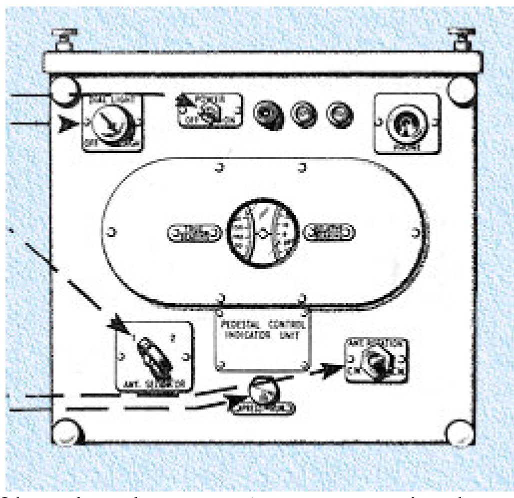
The two antennas that are the most likely to be needed should be mounted on the rotary antenna mount and polarized ahead of time, on the basis of known facts or suspected enemy operation.

The one of the two that is expected to be used should be connected inside the column to the lead that runs to the TDY-1. This must be done by hand until a changeover switch is provided for each mount.

Note the number of the antenna (I or II near top of mount(to which the lead is connected, and snap ANTENNA SELECTOR switch on the antenna control unit (shown below) to the same number (#1 or #2).

Obtain the bearing of the enemy radar by means of one of the following methods:

1. Ask CIC if the ship's radars have the bearing of the enemy target from which the radar signal is being picked up: for example, from an attacking plane.
2. If a high-frequency direction finder is in use, and can give satisfactory bearings, get the bearing of the enemy radar while the TDY-1 is off or in standby position.
3. If no CIC or direction -finder information is available, another method may be tried:
   A. Connect the TDY-1 antenna to the receiver by means of a special lead. This lead is not provided with the equipment, and must be made by the ship ahead of time.
   B. Use TDY-1 antenna control unit to train the antenna on the target. Watch the signal of the pulse-analyzer and pan-adaptor scopes, and listen to it in the headphones, to get point of maximum amplitude. Record the TRUE BEARING reading.
   C. Connect TDY-1 antenna to the TDY-1, and receiving antenna back on the receiver.



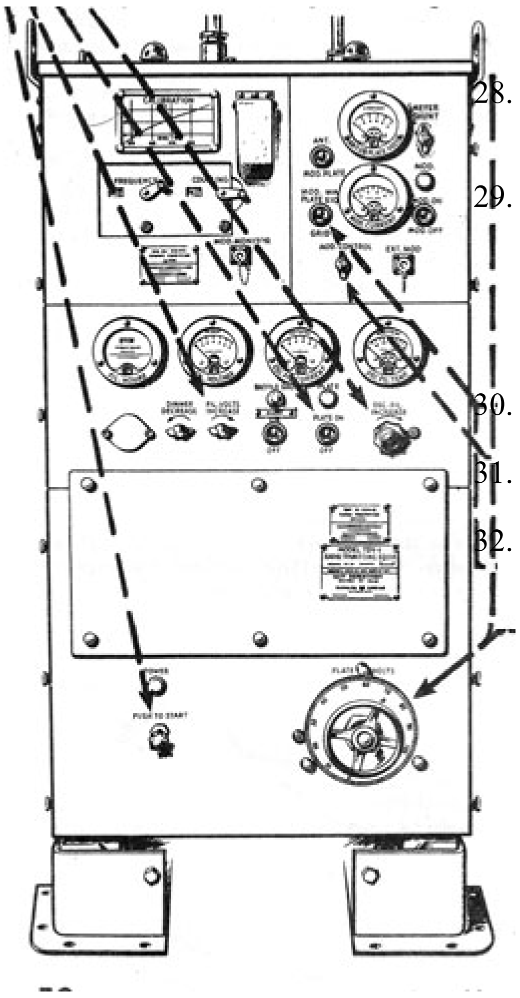
Get the antenna control set up:

1. Snap POWER switch to the right--ON.
2. Turn dial light all the way clockwise.
3. Position of ANTENNA SELECTOR switch must always be the same as connection in rotary antenna mount, otherwise the antenna will be 180° off the target.
4. To rotate antenna to any given bearing, use the right hand to snap the ANTENNA ROTATION switch to left for clockwise (CW) rotation, through neutral position in the center, and to right for counterclockwise CCW) rotation. While in CE or CCW positions, push button below dial with left hand to make the antenna move.

During ordinary operation the dial marker is kept as close as possible to the TRUE BEARING as a means of keeping the TDY-1 antenna trained on the target.

TO TURN THE TDY-1 ON:

19. Press PUSH TO START switch to on position. The lights POWER and MOD will glow.
20. Adjust FIL VOLTS knob until the FIL VOLTAGE meter above it reads 10.4 volts.
21. Turn the OSC FIL knob to get a reading of 1.1 .on the OSC FIL CURRENT meter. When using the 5J29 magnetron, also record reading of the OSC FIL TEMPERATURE meter.
22. Snap PLATE switch up--ON. Light above switch will go on (50 seconds time delay after PUSH TO START has been pressed).
23. After light above PLATE switch goes on turn PLATE VOLTS control clockwise until meters top right of panel) read: ANT OR PLATE VOLTAGE -- between .5 & .8, MOD CURRENT meter -- between 35 & 40.
24. Extra step for 5J29 only: Turn OSC FIL knob counterclockwise to get OSC FIL TEMP meter to read as near as possible to reading recorded in step 21, but not lower than 0.9 on OSC FIL CURRENT meter.
25. Snap MOD MA switch down--GRID position.
26. Adjust MOD CONTROL knob to obtain maximum reading on MOD CURRENT meter. It should read between 5 and 12 ma.



27. Snap MOD MA switch up to PLATE X 10.

28. Adjust PLATE VOLTS control to get a reading of 40 on MOD CURRENT meter, or .8 on ANT OR PLATE VOLTAGE meter, whichever value is reached first.

29. With the receiver tuned to the frequency on which the enemy signal is expected or is actually observed, turn the FREQUENCY control to move the TDY-1 jamming signal to the same place (usually the center) on the pan adaptor scope.

TO PUT THE TDY-1 IN STANDBY

30. Snap PLATE switch down to the off position.

31. Turn PLATE VOLTS hand wheel counterclockwise to 0 as soon as PLATE switch is off.

32. Extra step to conserve life of magnetron when TDY-1 is not needed immediately: Turn OSC FIL knob all the way counterclockwise. OSC FIL CURRENT meter will read 0.

THE ADVANTAGES OF SETTING UP THE TDY-1 AHEAD OF TIME

It is often possible to predict closely the frequencies that the enemy radar will use and which the TDY-1 will be needed to jam. One reason for this is that certain types of radars used by the enemy become known, and any new types they may have, require many months of work to develop, produce, and put into use.

It is a harder matter to predict when the TDY-1 will be needed, consequently it is good operating practice to save time by getting as much as possible done in advance. The instructions given in steps 1 to 33 make it possible to set a number of controls and leave them in one position, and to set others so that only minor adjustments will be needed when the transmitter is used to jam an enemy radar signal. The following is an outline of the procedure for doing the complete job once those steps have been done:

1. If the enemy radar signal appears at a frequency close to the one for which the TDY-1 is set up, proceed with steps 33 to 43 (do 40 & 41 only if necessary).

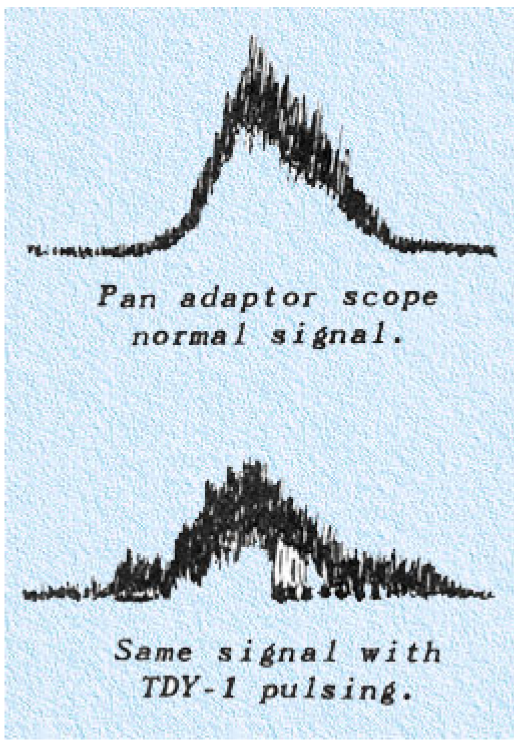
2. If the enemy radar signal appears at a different frequency that cannot be reached by the TDY-1 the way it is set up in advance, it will be necessary to do steps 3, 4, and 5, and then steps 19 to 43. In such a situation if speed in getting into action is more important than preventing the enemy from getting advance warning, the transmitter can be tuned up to the regular antenna (connect to transmitting antenna instead of dummy antenna in step 1), thus making it possible to eliminate steps 30 to 38.

THE PROBLEM OF PULSING

The TDY-1 radar jammer should be adjusted so that it does not pulse. The reason for this is that when the jamming transmitter is tuned to obtain maximum output with no pulsing it can be counted on to do a consistently better job of jamming an enemy radar than with any adjustment that permits the set to pulse.

The problem of detecting and eliminating pulsing is best taken care of by the preliminary calibration of each magnetron. No two magentrons behave exactly alike, but pulsing is most apt to occur with the 5J29 when the coupling control is advanced too far, and with the 5J32 when the attachments are used to extend its range.

There is no single foolproof method of checking the TDY-1 for pulsing, but there are a number of ways to recognize the ordinary signs (other indications such as occur with high-frequency pulsing may be very difficult to detect).


Pan adaptor scope normal signal.

Same signal with TDY-1 pulsing.

Some forms of pulsing may cause erratic behavior of the transmitter, and some may be heard in the phones as a low bussing sound in the background while listening to the jamming signal in the receiver.

Pulsing may sometimes be seen on the pan adaptor scope, as shown by the two sketches (made from actual photographs).

When a monitor oscilloscope is used with the transmitter, pulsing may appear as vertical lines in what would otherwise be an even glow on the scope.

TO STOP THE TDY-1

The best way to completely secure the equipment is to first put it in standby (Snap PLATE switch down--OFF. Turn PLATE VOLTS hand wheel counterclockwise to 0), and then pull out the PUSH TO START switch.

TO SET THE TDY-1 ON THE ENEMY RADAR SIGNAL

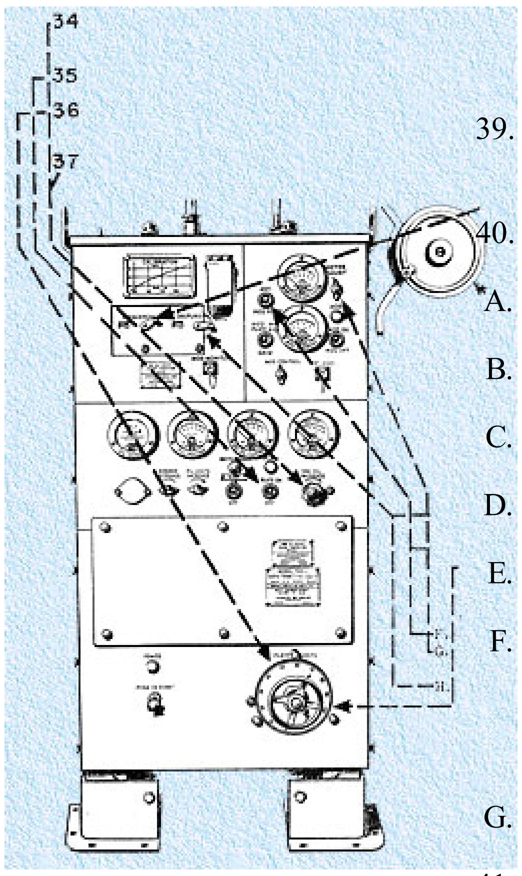
33. Connect transmitter to cable that leads to the proper transmitting antenna.

34. Turn OSC FIL knob to get a reading of 1.1 on the OSC FIL CURRENT meter. When using the 5J29 magnetron, also record reading on the OSC FIL TEMPERATURE meter.

35. Snap PLATE switch up--ON. Light above switch will go on to show it is working.

36. Turn PLATE VOLTS hand wheel clockwise to get readings of 40 on the MOD CURRENT meter, or .8 on the ANT OR PLATE VOLTAGE meter, whichever value is reached first.

37. Extra step fo 5J29 only: Turn OSC FIL knob counterclockwise to get OSC FIL TEMP meter to read same as in step 34, but not lower than 0.9 on OSC FIL CURRENT meter.



38. Turn FREQUENCY control to move TDY-1 signal to the same place on the pan adaptor scope as the enemy radar signal.

39. If the TDY-1 signal jumps over the center of the pan adaptor scope, or if a double hump is seen, turn the line stretcher a number of turns, and then adjust FREQUENCY control again.

40. If antenna coupling needs to be adjusted or calibrated, proceed as follows:

    A. Record true bearing if the antenna is trained on the enemy radar target.
    B. Rotate antenna to relative bearing that is used for adjusting coupling.
    C. Set COUPLING at 150 for 5J29, and 300 for 5J32 if not calibrated at all.
    D. Snap switch down to MOD PLATE.
    E. Adjust METER SHUNT knob so ANT OR PLATE VOLTAGE meter reads mid-scale.
    F. Adjust COUPLING control for maximum reading on ANT OR PLATE VOLTAGE meter, with no pulsing on monitor scope, or pan adaptor scope. Turn COUPLING with left hand, and keep right hand on ANT--MOD PLATE switch (Steps D. & F.) so that with changes in coupling, checks can be made for normal tube operation (Step E.)
    G. Train antenna on bearing of target.

41. If pulsing appears on the monitor scope or the pan adaptor scope, do as follows:

    A. Recheck adjustments and meter readings for normal operation (Steps 24 to 28).
    B. Adjust COUPLING control (usually to lower numbers) while at the same time keeping a close check of normal operating values (Step 40, D.F.G.&H.)

42. Check the frequency of the TDY-1 signal (Repeat steps 38 & if necessary).

43. Make a regular check of meter readings for normal operation of the transmitter.

CHECKING THE TDY-1 JAMMING OF THE ENEMY RADAR SIGNAL

When the TDY-1 has been set on the same frequency as the enemy radar signal, by getting both the TDY-1 signal and the enemy radar signal centered on the scope of the pan adaptor, it is necessary to check the following constantly:

1. The antenna must be kept on the bearing of the target. This can be done quickest with the help of CIC if the ship's radars have picked up the enemy target.
2. The TDY-1 must be checked for proper operating values as shown by the meter readings, and for good modulation without pulsing as shown on the scope.
3. The TDY-1 jamming signal must be kept precisely on the same frequency as the enemy radar signal. If both signals can be seen at the same time on the scope of the pan adaptor, it is a matter of keeping both signals on "top" of each other.

When the TDY-1 signal prevents the enemy radar signal from being seen on the scope of the pan adaptor, it requires that the transmitter be temporarily taken off the air in order to find out what the enemy radar is doing. If the officer-in-charge decides that the situation calls for a check on the enemy and how well the TDY-12 is jamming, the following steps should be done as quickly as possible:

1. Put the TDY-1 in STANDBY position, by snapping PLATE switch down--OFF. (Step 30). (If 5J29, turn OSC FIL knob to get 1.1 on the FIL CURRENT meter).
2. Turn up GAIN on the pan adaptor, and watch for the appearance of the enemy signal on the pan adaptor scope, and listen for the signal in the headphones.
3. If the enemy radar has shifted frequency, turn the receiver tuning dial to move the enemy radar signal to the center of the pan adaptor scope.
4. Check the bearing of the enemy radar by one of the following methods:
    1. Ask CIC if the ship's radars have the bearing of the enemy target from whom the radar signal is being picked up; for example, from an attacking plane.
    2. If a direction finder is in use, and can give satisfactory bearings, get the bearing of the enemy radar while the TDY-1 is off or is in standby position.
    3. If no CIC or direction-finder information is available, the following method may be used:
        1. Connect the TDY-1 antenna to the receiver by mens of the special cable.
        2. Use the TDY-1 antenna control unit to rotate the antenna back and forth through the target bearing while watching the signal on the pulse analyzer and pan adaptor scopes, and listening to it in the headphones, to get the bearing of maximum amplitude. Record the TRUE BEARING.
        3. Connect TDY-1 antenna to the TDY-1, and receiving antenna back to receiver.
5. Turn the pan adaptor GAIN to the level that will make it possible to see the TDY-1 signal as a pip on the scope fo the pan adaptor.
6. Snap the PLATE switch up--ON, etc. Follow steps 32 to 38 on the preceding page.

Transcribed and formatted by Patrick Clancey, HyperWar Foundation